U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

AC 120-29A

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Criteria for Approval of Nonprecision, Category I, and Category II WEATHER MINIMA FOR APPROACH AND LANDING

Forward

This advisory circular (AC) provides an acceptable means, but not the only means, for obtaining and maintaining approval of operations in Nonprecision, Category I, and II Landing Weather Minima including the installation and approval of associated airplane systems. It includes additional Nonprecision, Category I, and II criteria or revised Nonprecision, Category I, and II criteria for use in conjunction with Head-up Displays, and Category II during certain engine inoperative operations. Guidance material relating to RNAV, VNAV, RNP, and GLS operations is provided but specific criteria for these operations is published in other AC's and Orders. This revision also updates and incorporates provisions of the former AC 120-29 through Change 3 into the revised AC 120-29A.

This revision incorporates changes resulting from the first steps toward international all weather operations (AWO) criteria harmonization taken by the Federal Aviation Administration (FAA), European Joint Aviation Authorities (JAA), and several other regulatory authorities. Subsequent revisions of this AC are planned as additional all weather operations harmonization items (AHI) are agreed and completed by FAA, JAA, and other regulatory authorities.

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APPENDIX 3 DEFINITIONS AND ACRONYMS

1. PURPOSE. This advisory circular (AC) provides an acceptable means, but not the only means, for obtaining and maintaining approval of Nonprecision, Category I, and Category II Weather Minima including the installation and approval of associated airplane systems. This AC is applicable to Title 14 of the Code of Federal Regulations (14 CFR) parts 121, 135, and those part 125 operators not exempted under section 125.1 or not having received an applicable deviation authorization under section 125.3. Certain aspects of this AC are applicable to 14 CFR part 129 operators. Many of the principles, concepts and procedures described also may apply to 14 CFR part 91 operations and are recommended for use by those operators when applicable. Mandatory terms used in this AC such as "shall" or "must" are used only in the sense of insuring applicability of these particular methods of compliance when the acceptable means of compliance described herein is used. This AC does not change, add, or delete regulatory requirements or authorize deviations from regulatory requirements.

a. Major changes introduced in this revision include new provisions for Head Up Display (HUD) and revised requirements for Nonprecision, Category I, and II.

b. With issuance of AC 120-29A, the former AC 120-29, Criteria for Approving Category I, and Category II Landing Minima for FAR 121 Operators, dated September 25, 1970, is canceled.

2. RELATED REFERENCES AND DEFINITIONS.

2.1. Related References.

a. Regulations. 14 CFR part 25, sections 25.1309 and 25.1329; 14 CFR part 91, sections 91.175, and 91.189; 14 CFR part 121, sections 121.579, and 121.651; 14 CFR part 125, sections 125.379, and 125.381; 14 CFR part 129, section 129.11; and 14 CFR part 135, section 135.225.

b. AC's. Current editions of Advisory Circulars: AC 120-28, Criteria for Approval of Category III Landing Weather Minima; AC 20-129, Airworthiness Approval of Vertical Navigation (VNAV) Systems for Use In the U.S. NAS and Alaska; 20-RNP, Airworthiness Approval of Required Navigation Performance, AC 20-130, Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors; AC 20-138, Airworthiness Approval of Global Positioning System (GPS) Navigation Equipment for Use as a VFR and IFR Supplemental Navigation System; AC 25-15, Approval of Flight Management Systems in Transport Category Airplanes, AC 90-RNP RNAV, Operational Approval for Required Navigation Performance (RNP) Area Navigation (RNAV), AC 90-45B, Approval of Area Navigation Systems For Use in the U.S. National Airspace System,
AC 90-96A, Approval of U.S. Operators and Aircraft to Operate Under Instrument Flight Rules (IFR) in European Airspace Designated for Basic Area Navigation (BRNAV/RNP-5).

c. Orders. Federal Aviation Administration (FAA) Orders 8400.8, Procedures for Approval of Facilities for FAR Part 121 and Part 135 CAT III Operations; 8400.10, Air Transportation Operations Inspector's Handbook; 8400.13, Procedures for the Approval of Category II Operations and Lower Than Standard Category I Operations on Type I Facilities; 8400.TLS, IFR Approval for Transponder Landing System, Special Category I Approaches; 6750.24, Instrument Landing System (ILS) and Ancillary Electronic Component Configuration and Performance Requirements; 8200.1, U.S. Standard Flight Inspection Manual; 8260.3, U.S. Standard for Terminal Instrument Procedures (TERPS); 8260.31, Foreign Terminal Instrument Procedures, 8260.36, Civil Utilization of Microwave Landing System (MLS) 8260.48, Area Navigation (RNAV) Approach Construction Criteria and other 8260 series documents.

d. OpSpecs. Operations Specifications Part A and C.

e. Foreign. Joint Aviation Authority (JAA) ACJ AWO 231, Flight Demonstration (Acceptable Means of Compliance) dated August 1996.

f. Other. RTCA DO-236, Minimum Aviation System Performance Standards: Required Navigation Performance for Area Navigation

2.2. Definitions.

a. In this document Category I and Category II are defined as:

(1) Category I - A precision instrument approach and landing with a decision height not lower than 60m (200 ft) and with either a visibility not less than 800m (2400 ft), or a runway visual range not less than 550m (1800 ft) (adapted from International Civil Aviation Organization (ICAO) - IS&RP Annex 6).

(2) Category II - An ILS approach procedure which provides for approach to a height above touchdown of not less than 100 ft and with runway visual range of not less than 1200 ft. (AIM).

b. Within this AC, Runway Visual Range (RVR) values are specified in units of feet (ft.) unless otherwise noted (e.g., meters (m)). Where visibility minima are stated in both feet and meters (e.g., RVR 300 (75m)) using values other than those identified as "equivalent" in standard operations specifications (OpSpecs), it is intended that the RVR value in feet apply to minima specified in feet, and the value in meters apply in states specifying their minima in meters.

c. Also in this AC, where the term "Required Navigation Performance (RNP) Level" is used, it may be considered to be equivalent to the term "RNP Type" typically used in some current ICAO and other authority references.

3. BACKGROUND.

3.1. Major Changes Addressed in this Revision. This advisory circular includes additional Nonprecision, Category I, and Category II criteria or revised Category II criteria for use of Head-up Displays and "engine inoperative" Category II approach procedures. This revision expands on existing information regarding Category I approach procedures. Instrument Landing System (ILS), Microwave Landing System (MLS), and Global Positioning System (GPS) or GNSS Landing System (GLS) procedures are addressed as Category I approach procedures because they may be viewed as providing electronic guidance (lateral/vertical) of relatively high precision. This revision incorporates changes resulting from the first steps toward international all weather operations (AWO) criteria harmonization taken by the FAA, European JAA, and several other regulatory authorities. Subsequent revisions of this AC are planned to reflect evolving all weather operational concepts and criteria.

3.2. Relationship of Operational Authorizations for Nonprecision, Category I, or Category II and Airborne System Demonstrations. Approach weather minima are approved through applicable operating rules, use of approved instrument procedures, and issuance of OpSpecs*. Airworthiness demonstration of airplane equipment is usually accomplished in support of operational authorizations on a one time basis at the time of Type Certification (TC) or Supplemental Type Certification (STC), and continuing airworthiness must also be addressed to ensure that the airplane continues to comply with the airworthiness regulations. This demonstration is typically based upon the airworthiness criteria in place at the time of the original airplane approval. Since revisions of operating rules apply to all airplanes whereas revisions of airworthiness rules only affect new airplane, additional Nonprecision, Category I, or Category II operational approval or constraints may apply to operators or airplanes as necessary based on safety experience. In general, criteria related to operational approval is contained in the main body of this AC and criteria related primarily to the airworthiness demonstration of systems or equipment is included in the appendices to this AC.

***NOTE: OpSpecs are unique Federal Aviation Regulations applicable to a particular operator. OpSpecs are based on the regulations; however, they are specifically applicable to and tailored to a particular operator's airplane, routes, and operating circumstances. Standard OpSpecs are developed by FAA and provided to FAA field offices to aid in development and issuance of the particular and unique OpSpecs issued to each operator.**

3.3. Application of this Advisory Circular. New "operational authorizations" should use the criteria of AC 120-29A. New "airworthiness approvals" should use the guidance in Appendix 1 and 2 of this AC and when applicable the appropriate airworthiness guidance (e.g., AC 20-138). Airworthiness demonstrations may use equivalent JAA criteria where agreed by FAA through the FAA/JAA criteria harmonization process. Operators electing to comply with these revised criteria may receive additional operational approval when using the revised criteria. Airplane manufacturers or modifiers may elect to demonstrate their airplane using the revised criteria to seek additional capability. Airplanes demonstrated using earlier criteria may continue to be approved for Nonprecision, Category I, or Category II operations in accordance with (IAW) that earlier criteria. Operators seeking additional capability provided for in this AC must use the criteria in this AC.

3.4. Requirement for Flight Inspection Prior to Operations. All instrument approach procedures (U.S. Standard; other than U.S. Standard, Special, and FAA/JAA) in the U.S. and its territories must be evaluated by FAA Aviation System Standards (AVN), Flight Inspection Operations Division, before final approval for flight operations.

4. OPERATIONAL CONCEPTS.

4.1. Classification and Applicability of Minima. 14 CFR parts 91, 97, 121, 125, 129, 135, and standard OpSpecs Part C generally address takeoff and landing minima. Although a wide variety of normal and non-normal situations are considered in the design and approval of systems and procedures for Nonprecision, Category I, and Category II, landing weather minima are primarily intended to apply to normal operations. For non-normal operations, flightcrews are expected to take the safest course of action appropriate for the situation, notwithstanding landing weather minima. When airplane systems have been demonstrated to account for certain non-normal configurations and a procedure is specified (e.g., an approach with an engine inoperative non-normal procedure) flightcrews may take account of this information in assessing the safest course of action.

4.1.1. GNSS and Reference Datum Information. Satellite systems authorized for use by U.S. operators include GPS and FAA authorized augmentation systems for use with GPS (e.g., WAAS or LAAS). These systems may be used in the U.S., in U.S. territories, in other States that authorize GPS use, or in international airspace.

a. When using GPS or navigation systems in airspace outside of the U.S., it is the responsibility of the operator to assure that an appropriate Reference Datum (e.g., WGS-84) is used for waypoint or critical path point coordinates. Information on States using WGS-84 or various other databases is typically available from commercial charting sources and the worldwide web.

b. Satellite systems other than GPS may be used only as approved by the CHDO/POI following coordination with the Flight Technologies and Procedures Division, AFS-400, and authorized through operation specifications.

4.2. Approach and Landing.

4.2.1. Approach and Landing Concepts and Objectives.

a. Nonprecision and Category I operations may be conducted using situation information to flight guidance displays (flight directors), or by using approved autopilot or autoland systems. However, air carrier operations, particularly with turbine powered airplanes, typically have minima restricted by OpSpecs if a flight director or autopilot is not used.

(1) Basic airworthiness certification for Instrument Flight Rules (IFR) under provisions of 14 CFR part 25 is considered an acceptable means of demonstration of capability for operational acceptance of an airplane and its associated systems.

(2) It is expected for non-normal operations (e.g., engine(s) inoperative, hydraulic or electrical system(s) failure) the pilot or operator should consider any necessary adjustment of operating minima, wind limit constraints, or other factors to ensure safe operation with the non-normal condition.

b. Category II operations may be conducted manually using situation information to flight guidance displays (flight directors), or using approved autopilot or autoland systems. However, most Category II operations are conducted using an autopilot or autoland system, or with combinations of systems using both automatic and flight guidance (e.g., flight director) elements. Additional demonstration or operational assessment is typically necessary for operational authorization of an airplane for Category II (see paragraph 5 and Appendix 1). Certain non-normal conditions are typically considered in the assessment and authorization process (OpSpecs). It is expected for non-normal operations (e.g., engine(s) inoperative, hydraulic or electrical system(s) failure) the pilot or operator should consider any necessary adjustment of operating minima, wind limit constraints, or other factors to ensure safe operation with the non-normal condition.

c. ICAO Annex 6 has been amended to include a new approach classification intended to authorize and encourage the use of vertical guidance on approach procedures other than those satisfying the conventional criteria for a precision approach (including both the performance of the navigation system as well as the runway and airport infrastructure). <u>While the FAA endorses this concept and has implemented VNAV criteria that falls into this category, these procedures are within the category of nonprecision approach procedures until the ICAO classification can be incorporated into the appropriate FAA regulatory and guidance material.</u> The FAA approach categories include:

(1) Nonprecision approaches without vertical guidance

(2) Instrument approaches with vertical guidance

(3) Precision approaches with vertical guidance

4.2.1.1. Operational Safety Evaluation.

a. For any instrument approach using Nonprecision, Category I, or Category II minima, the operator must adequately consider and provide for safe operations considering at least the following: (See paragraph 10.15.1)

(1) The possibility of a failure of any one of the pertinent navigation systems, flight guidance system, flight instrument system, or annunciation system elements used for the approach or missed approach (e.g., ILS receiver failure, Autopilot disconnect, etc.).

(2) The possibility of a failure of a key airplane component or related supporting system during the approach or missed approach (e.g., engine failure, electrical generator failure, single hydraulic component failure). Even though a particular failure may in itself be considered too remote based on exposure time (e.g., engine failure), it is nonetheless important to address these considerations since, in practical circumstances, a "go-around" may be due to a factor which relates to or leads to the failure, and thus is not an independent event (e.g., bird ingestion). This is consistent with the long standing principle of safety of operation of multi-engine airplanes in air carrier operations which notes that after passing V_1 on take-off, until touchdown, the airplane should typically be able to sustain a failure such as engine failure and still safely be able to continue flight and land.

(3) The possibility of a balked landing or rejected landing at or below Decision Altitude (Height) (DA(H)), or Minimum Descent Altitude (MDA), as applicable.

(4) The possibility of loss or significant reduction of visual reference, that may result in or require a go-around.

(5) Suitable obstacle clearance following a missed approach, considering applicable airplane configuration during approach and any configuration changes associated with a go-around (e.g., engine failure, flap retraction).

(6) For special airports identified IAW 14 CFR 121.445 (e.g., mountainous terrain), or other airports with critical obstacles that have not otherwise been accounted for, the ability to assure suitable obstacle clearance following a rejected landing; applicable airplane configuration(s) during approach and any configuration changes associated with a go-around and missed approach should be considered.

(7) Unusual atmospheric or environmental conditions that could adversely affect the safety of the operation (e.g., extreme cold temperatures, known local atmospheric or weather phenomena that introduce undue risk, etc.).

b. When conducting a safety assessment of issues listed above, and uncertainty exists as to airplane failure condition effects, procedural design intent or margins, airplane characteristics or capabilities following failure, or other such issues, the operator should consult with an appropriate organization source able to provide reliable and comprehensive information. Typically this includes consultation with one or more of the following as applicable, and as necessary:

- Airplane manufacturer
- Avionics manufacturer
- Procedure designer
- Air Traffic Service provider, or regulatory authority

NOTE: For definitions of the terms "balked landing," "rejected landing," "go-around," and "missed approach," see Appendix 3.

4.2.1.2. Use of ICAO Standard Navigational Aids (NAVAID). U.S. Nonprecision, Category I, or Category II operations are based on the use of ICAO standard NAVAIDs, equivalent NAVAIDs, or other NAVAIDs acceptable to FAA and approved in OpSpecs. Authorization for use of NAVAIDs other than ICAO Standard NAVAIDs or NAVAIDs acceptable to FAA must be coordinated with the Flight Standards Service (AFS), Aviation System Standards (AVN), Airways Facilities (AAF), etc.

4.2.1.3. Instrument Approach Procedures (IAPs). The operator must ensure consideration of at least the following factors related to use of instrument approach procedures:

a. Acceptable Instrument Approach Procedures. Instrument approach procedures used by operators in accordance with this AC should be:

(1) U.S. Standard Instrument Approach Procedures;

(2) For foreign airports, foreign instrument approach procedures acceptable to FAA promulgated by the state of the airport of landing (i.e., ICAO - State of the Aerodrome). The operator may propose use of such procedures for POI, APM, or CMO acceptance;

(3) U.S. military instrument procedures acceptable to FAA for operations at military facilities. The operator may propose use of such procedures for POI, APM, or CMO acceptance; or

(4) Special instrument approach procedures approved by the FAA (developed by the FAA, the operator, or the State of the aerodrome).

b. Considerations for use of IAPs. The operator must ensure consideration of at least the following factors related to use of IAPs:

(1) Availability of suitable weather reporting and forecasts;

(2) Identification of any necessary alternates airports or alternate minima;

(3) Ability to discontinue an approach, if necessary, from any point to touchdown;

(4) Suitability of the airborne equipment to use the procedure (e.g., compatibility of the airborne equipment with the type/characteristics of the ILS, Very High Frequency (VHF) Omni-directional Radio Range (VOR), Distance Measuring Equipment (DME), Non-directional Beacon (NDB), Global Navigation Satellite System (GNSS) facilities used);

(5) Suitability of Ground Systems/Equipment (e.g., lighting, transmissometers, pilot control of lighting);

(6) Suitability of NAVAIDs (e.g., maintenance, monitoring);

(7) Suitability of Airport/Runway (e.g., obstructions, clear zones, markings);

(8) Availability of Aeronautical Information (e.g., timely NOTAM availability);

(9) Identification of any special Training or qualification related to the procedure; and

(10) Resolution of any issues identified from adverse "service experience" with the procedure.

4.2.1.4. Constant Descent Approach Concepts. The concept of the constant descent approach is to achieve a constant angle vertical flight path through out the final approach segment using a method described below. The flightcrew will be expected to operate the aircraft using stabilized approach techniques for the control of configuration, energy, and flight path. The objective is to fly the approach in a stabilized manner in terms of configuration, energy, and control of the flight path. It is recommended that all runways serving air carrier operations have approach and landing systems with vertical guidance. In the absence of these precision systems, constant descent approach concepts should be utilized to the greatest extent feasible. Operators should choose a method appropriate to the capabilities of their "classic," "standard," or "advanced" aircraft, flight training, and Standard Operating Procedures.

a. General Procedure Requirements.

(1) Obstacle clearance protection will be provided for the visual transition to landing segment of all 14 CFR part 97 nonprecision approach procedures designed for constant descent to a decision altitude (DA).

(2) Using a constant descent approach profile similar to an ILS, including go-around, facilitates acquisition of visual cues at normal aircraft deck angles, reduces pilot workload, increases fuel efficiency, reduces noise levels, etc.

(3) Nonprecision approach procedures should have the final approach descent angle published on the chart.

(4) When amended, nonprecision approach procedures should be revised to provide an optimum final approach segment that is approximately equivalent to a 3-degree descent angle.

(5) Nonprecision approach procedures may be designed using angles up to 3.77 degrees. Constant descent approach procedure design should normally be limited to angles between 2.75 and 3.5 degrees. Operationally, it is recommended that the maximum angle used not exceed the degree equivalent of 1000' per minute rate of descent for the largest category of aircraft normally expected to use the approach procedure.

(6) Use of the constant descent approach requires the pilot to execute a missed approach if, prior to the MDA/DA, the pilot does not acquire the required visual references as described in 14 CFR 91.175. With the required visual reference the pilot may continue through the MDA/DA using stabilized approach techniques.

(7) Operational procedures should be developed to provide height cross checks with known distance from threshold or DME distance values. It is important to insure that stepdown fix altitudes are not penetrated.

(8) It is recommended that a VGSI be provided for nonprecision procedures set at a value equivalent to the final approach descent angle.

b. Currently, four methods of constant descent approaches are defined.

(1) Vertical speed, timing, and final approach course guidance;

(2) Vertical speed, DME, and final approach course guidance;

(3) 2D RNAV using Vertical speed and LNAV;

(4) 3D RNAV using VNAV and LNAV.

c. All aircraft may be authorized to use the vertical speed/timing or vertical speed/DME methods. Use of these methods will require the operator to provide operational procedures that assure that during missed approach, the aircraft does not descend below MDA. To meet this requirement, the operator must add a "buffer value" equal to, or greater than, the demonstrated height loss of the aircraft to the MDA. The resulting value becomes the pilot's derived DA.

d. Standard and Advanced aircraft may be authorized the 2D RNAV method using vertical speed and LNAV or the 3D RNAV method using VNAV/LNAV. Operators using these methods may be authorized the use of a DA in lieu of an MDA providing:

(1) An appropriate obstacle assessment has been made for the visual segment of the approach procedure.

(2) For 3D RNAV using VNAV/LNAV:

(a) The descent path is appropriately coded in the flight management system database.

(b) Operational procedures are developed to permit standard and advanced aircraft to track the computed path to a DA, defined by the point where the descent path crosses the MDA.

4.2.1.5. Straight-in Approach Path Descent Angle Constraints. Approach path angles between 2.75 degrees and 3.77 degrees are considered the range for normal air carrier operations. Approach angles above 3.77 degrees are considered "steep angle approaches." Authorization of steep angle approaches require additional assessment and air carrier use requires coordination with AFS-400. Use of approach path angles greater than 4.5 degrees should normally be based on an airplane type AFM provision for "steep angle approaches," IAW AC 25-7A, Flight Test Guide for Certification of Transport Category Airplanes, or equivalent, and paragraph 6.8 of Appendix 1.

4.2.1.6. Maneuvering Considerations. 14 CFR part 91, section 91.175 requires that approach procedures should be based on use of normal maneuvers before and after passing DA(H) or MDA. Normal maneuvers typically do not exceed bank angles of 30 degrees, pitch attitudes of 25 degrees nose up or 10 degrees nose down, or sink rates of 1000 ft. per minute when below 1000 ft. Height Above Airport (HAA). These norms apply while performing an approach, while maneuvering to land within the touchdown zone, while performing a go-around, and while performing a rejected landing. During a missed approach, pitch attitudes in excess of +30 degrees or bank angles greater than 30 degrees would typically be considered excessive.

4.2.1.7. Non-Normal Events or Configurations. Published landing weather minimums are intended for normal operations. When non-normal events occur, flightcrews are expected to take the safest course of action to assure safe completion of the flight. Using emergency authority, crews may deviate from rules or policies, to the extent necessary for the circumstances, to minimize risk during landing. Paragraph 6.1.7 addresses guidelines and procedures to be considered in conducting an instrument approach during a non-normal event.

4.2.1.8. Go-Around Safety.

a. TERPS or ICAO PANS-Ops based criteria do not address non-normal operations (e.g., engine inoperative) or operations below DA(H) or MDA. Therefore, during preflight planning/dispatch the following assessments should be performed and appropriate guidance should be provided to flight crews. A multiengine aircraft conducting an instrument approach should be capable of safely executing a "one-engine-inoperative" go-around from any point in an approach prior to touchdown with the aircraft in a normal configuration, or specified non-normal configurations. This is necessary to provide for go-around safety due to missed approaches or rejected landings due to a variety of circumstances such as:

- Unexpected environmental conditions (e.g., cross winds, turbulence)
- Airplane related failures (e.g., gear unsafe)
- Air Traffic Service contingencies (e.g., Rejected Take-off (RTO) on a crossing runway)
- Loss of visual reference
- When a pilot finds the runway surface unsuitable (e.g., clutter, birds)
- When the runway is blocked (airport vehicles or exiting airplanes ahead not clear), or

due to a go-around or missed approach due to any other reason

(1) This objective may be achieved by the operator providing information to flight crews on an appropriate lateral flight path to follow to enable the aircraft to safely operate to the runway, and out from the runway following a rejected landing. In the rare event that a normal operation out of a runway may not be possible following a rejected landing, then provision for alternate procedures (e.g., limit weight, minimum speed, or suitable configuration) may be approved by the FAA on a case-by-case basis. The intent of providing information on safe go-around capability is to identify the best option or options for a safe lateral ground track and flight path to follow in the event that a missed approach, balked landing, rejected landing or go-around is necessary.

(2) While coping with the go-around contingency during low visibility operations, the pilot has minimum time to respond, and may have limited visual reference available to safely cope with the adverse condition (e.g., night and poor visibility). Further, "Go-around" safety should be addressed regardless of when an engine failure may occur prior to landing. However,

operators may elect to distinguish between procedures or expected crew response for engine failures occurring at various times during a flight as follows:

(a) Engine failure occurring enroute or prior to passing a final approach fix or point,

(b) Engine failure during a final approach segment, or

(c) Engine failure after passing DA(H) or after descending below MDA but prior to touchdown, or during a go-around or missed approach.

(3) For engine failure occurring prior to final approach, in-flight diversion planning should allow for the potential need for a missed approach or balked landing, and for the need to maintain subsequent suitable obstacle clearance (e.g., when making suitable sections 121.161, 121.191, or 121.193 diversion choices). The pilot should consider any adjustment to minima, procedures or missed approach path that may be appropriate to facilitate safe obstacle clearance (e.g., following an FAA approved Takeoff Procedure (T-Procedure) or Departure Procedure (DP)). This is particularly appropriate if U.S. TERPS or ICAO PANS-Ops specified instrument procedural gradients cannot be met during any portion of a go-around or missed approach, or if following a suitable lateral path cannot be assured (e.g., crosswinds with no course guidance available, cannot maintain VMC, or at night).

(4) For engine failure during an approach, the pilot should consider the advisability of discontinuing the approach and diverting to a different airport or runway, to better assure safe missed approach or balked landing obstacle clearance.

(5) For engine failure after passing DA(H) or descending below MDA, the pilot should be prepared to expeditiously follow or join any pre-established and applicable "T-Procedure" or "DP", or equivalent (e.g., local air traffic guidance), until becoming established on a published segment of the missed approach procedure, at or above a safe altitude.

(6) Accordingly, an operator should have reviewed the missed approach and rejected landing flight path during preflight/dispatch. This is to assure that in the event of a go-around the aircraft has sufficient performance capability to assure safe obstacle clearance following a missed approach or go-around.

b. Go-Around Assessment Considerations. Operators should conduct an assessment for a particular runway, procedure, aircraft type, and expected performance for each specific flight. Some operational considerations include:

(1) Go-around configuration transitions from approach to missed approach configuration including expected flap settings and flap retraction procedures,

(2) Expected speed changes,

(3) Appropriate engine failure and shutdown (feathering if applicable) provisions, if the approach was assumed to be initiated with all engines operative,

(4) Any lateral differences of the missed approach flight path from the corresponding takeoff flight path,

(5) Suitable balked landing obstacle clearance, until reaching instrument approach missed approach or enroute procedurally protected airspace (e.g., section 121.189),

(6) Any performance or gradient loss during turning flight, if necessary to follow a flight path that is not over the runway or is not aligned with the runway after the balked landing transition,

(7) Any related situations such as the inability to dump fuel and the need to make an emergency return landing above maximum landing weight immediately after takeoff.

(8) Methods used for takeoff analysis, such as engine-out best climb angle, or other such techniques if approved by the FAA.

(9) Applicable flight guidance system operational procedures. Information required to achieve the specified aircraft performance should be available to the flight crew (e.g., appropriate mode selection),

(10) Operators may make obstacle clearance assumptions similar to those applied to corresponding takeoff flight paths (e.g., 14 CFR 121.189).

c. Go-Around Assessment Conditions.

(1) As a minimum, operators should use the assessment conditions listed below to account for the transition, reconfiguration, and acceleration distances following go-around:

(a) A "balked landing" starts at the end of the touchdown zone (TDZ).

(b) An engine failure occurs at the initiation of the balked landing, from an all-engine configuration.

(c) Balked landing initiation speed $\geq V_{REF}$ or V_{GA} (as applicable).

(d) Balked landing initiation height is equal to the specified elevation of the TDZ.

(e) Balked landing initiation configuration is normal landing flaps, gear down.

(f) At the initiation of the maneuver, all engines are at least in a spooled-up configuration.

(g) The expected landing weight.

(h) The planned landing flap setting.

(2) The TDZ is considered to be the first 3000' feet of usable runway, unless otherwise specified by the FAA. Consideration of an alternative TDZ may be appropriate for runways that are:

- Less than 6000' and do not have standard TDZ markings
- Designated short runways that require special limitations (e.g., landing weight, landing flap settings, etc.) or procedures for landing
- Runways for STOL aircraft, or
- Runways where markings or lighting dictate that a different TDZ designation would be more appropriate.

d. "One Way" Airports or Other Special Situations. Where obstacle clearance limits aircraft performance, the operator should develop and obtain FAA approval for a contingency go-around path for situations such as:

(1) "One-way in," "opposite way out" airports in mountainous terrain;

(2) Runways for which a landing is planned at a weight significantly greater than allowed for a takeoff; or

(3) Where balked landing obstacle clearance is not readily assured, operations require FAA approval.

e. Flight Guidance System (FGS) Use. If not already assessed during basic type certification, FGS suitability for the intended procedure(s) should be considered. The operator should assess FGS-mode use to assure compatibility with intended flight path, mode transitions, and climb gradient limitations. This may be achieved by demonstrating to the FAA, by simulation or flight, a safe go-around from 100 feet above the touchdown zone for the specific procedure or, if applicable, for the most critical runway for that operator. Airworthiness demonstrations conducted in accordance with Appendix 1 or 2 of this advisory circular or AC 120-28D address this provision.

f. Availability and Use of Performance and Obstacle Data.

(1) Data used by the operator for this assessment should be from applicable aircraft manuals, terrain or obstruction charts, or supplementary information from aircraft or engine manufacturers. If the performance, obstacle or flight path data is not available to support the analysis from the above sources, the operator shall develop and demonstrate the necessary data. The data may be derived by using standard practices applicable to aircraft performance assessment or by appropriate aircraft performance, or by engineering analysis, techniques or methods.

(2) Terrain or obstruction data for these assessments shall be the best available information to the operator, to the agency, or entity supporting the operator.

g. Related Information. Other paragraphs of this AC contain information related to this paragraph. Paragraph 5.14 describes typical factors to be considered when assessing go-around capability for a particular aircraft and flight guidance system. Paragraph 6 addresses procedures including those used for go-around or rejected landing, and paragraph 7 addresses Training and Crew Qualification including relevant aspects of missed approach, go-around, or rejected landing.

4.2.2. Precision Instrument Approach Operations.

> **NOTE: In this AC, xLS is a generic term to refer to ILS, MLS, or GLS and is not meant to**
>
> **infer a cockpit annunciation or charting convention.**

a. ILS, MLS and GLS (i.e., xLS) operations may be authorized to the lowest applicable DA(H) for the procedure used, and to the lowest visibility minima specified in the OpSpecs for the NAVAID, facilities, and lighting systems used (see Standard OpSpecs Part C Paragraph C053 for Category I, and Standard OpSpecs Part C paragraph C059 for Category II). Category II operations are typically authorized based on use of two or more navigation receivers or multi-mode receivers (MMRs) of a pertinent type (see 14 CFR 121.349 and 125.203), each providing independent information to the appropriate flight guidance system elements and pilot displays. This may include two or more independent multi-mode receivers (MMR's) of a pertinent type or a combination of receivers (see 14 CFR 121.349 and 125.203), each providing independent information to the appropriate flight guidance system elements and pilot displays. Provisions of 14 CFR 121.349 for use of a single ILS navigation receiver are typically limited to operations using minima at or above RVR4000, or for Minimum Equipment List (MEL) authorization for dispatch with a NAVAID receiver inoperative.

b. Precision Approach Radar (PAR) procedures or international equivalent procedures may be used but are not considered xLS procedures.

4.2.3. Nonprecision Instrument Approach Procedures WITH Vertical Guidance.

a. RNAV procedures with vertical guidance are published with Lateral Navigation (LNAV/VNAV) minimums. The obstacle clearance criteria for these approaches are predicated on the vertical guidance, and provides a sloping vertical surface under the desired path. These procedures are intended to be flown in a manner consistent with precision approaches, and can use a similar training program. RNAV procedures may allow different combinations of navigation sensors to be used to determine airplane location. GPS and space-based augmentation systems (SBAS) are acceptable navigation sensors for all RNAV procedures. Any of these sensors may also be combined with sensor information from one or more Inertial Reference Systems (IRS).

b. VNAV can be combined with ground-based nonprecision instrument approaches by using the RNAV system to overlay the procedure associated with the underlying navigation aid. The use of a DA in lieu of an MDA requires an obstacle assessment of the visual segment, and the obstacle clearance criteria for the IMC portion of the approach are identical to the criteria for the relevant nonprecision approach (e.g., VOR). These procedures are intended to be flown in a manner consistent with precision approaches, and can use a similar training program with the exception of monitoring the underlying NAVAID.

4.2.4. Nonprecision Instrument Approach Procedures WITHOUT Vertical Guidance.

> **NOTE: The use of pilot technique to maintain a constant descent is recommended but is not considered vertical guidance (see paragraph 4.2.1.4).**

a. Ground-Based Instrument Approaches.

(1) Instrument approaches whose flight path are defined relative to the location of a ground-based navigation facility include:

- Localizer (LOC)
- Localizer Back Course (BC)
- Simplified Directional Facility (SDF)
- Localizer-Type Directional Aid (LDA)
- VOR
- VOR/DME
- NDB
- Dual NDB
- NDB/DME
- Tactical Air Navigation system (TACAN)

(2) While these approaches are published without vertical guidance, it may be desirable to fly these approaches augmented by VNAV. This provides a constant descent to touchdown, enhancing safety. The existence of vertical guidance information does not change the requirement of section 91.175 for operation below MDA. Criteria and procedures authorizing a DA in lieu of an MDA for certain existing instrument approach procedures meeting specified obstacle assessment provisions are contained in HBAT 99-08/HBGA 99-12,Vertical Navigation (VNAV) Approach Procedures Using DA(H); OpSpec C073.

b. RNAV Instrument Approaches.

(1) Instrument approaches whose flight path is not defined relative to the location of a ground-based navigation aid include:

- VOR/DME RNAV. A procedure based on area navigation provided by a specified NAVAID (e.g., when a particular VOR/DME is specified as a "Procedure tuned" facility to serve as a basis for a particular RNAV procedure)
- GPS or RNAV (GPS). A procedure based on the use of satellite navigation (GPS or SBAS).
- RNP RNAV: An RNAV procedure requiring a specific level of navigation performance, which may also identify specific navigation aids/sensors suitable for the approach (e.g., GPS or DME/DME). Airworthiness and operational criteria for RNP RNAV operations can be found in AC 20-RNP and AC 90-RNP, respectively.

NOTE: Any of these sensors may also be combined with sensor information from one or more Inertial Reference Systems (IRS).

(2) While these approaches are published without vertical guidance, it is recommended that they be flown augmented by VNAV or as a constant descent approach. The use of VNAV does not change the requirement of section 91.175 for operation below MDA. Criteria and procedures authorizing the use of a DA in lieu of an MDA for those instrument approach procedures meeting specified obstacle assessment provisions are contained in HBAT 99-08 and HBGA 99-12.

NOTE: For the purpose of this AC, a "3D" approach procedure (3D) is considered to be one having both lateral and vertical path guidance. A "2D" approach procedure (2D) is

considered to be one having only lateral path guidance.

c. Airport Surveillance Radar (ASR) Procedures. ASR or international equivalent procedures may be used.

4.2.5. Applicability of a DA, DH, MDA, or Minimum Descent Height (MDH).

a. General.

(1) Instrument approach operations have limitations related to the minimum altitude or height to which a descent may continue or by which a missed approach must be initiated if the required visual references (e.g., 14 CFR section 91.175) to continue the approach have not been established. The published minimum altitude or height is related to assurance of clearance over terrain or obstacles, airborne instrumentation and equipment, NAVAIDs, and visual aids. Such a minimum altitude or height is usually specified as a Decision Altitude (DA), Decision Height (DH), MDA, MDH. The U.S. equivalent minima to be used for international minima specified in other terms are also described below for various types of approaches.

(2) The lowest permissible DA(H) or MDA for any approach should not be lower than the most restrictive of the following, as applicable:

- Minimum height or altitude published or otherwise established for the instrument approach
- Minimum height or altitude authorized in OpSpecs for the approach
- Minimum height or altitude authorized for the flightcrew
- Minimum height or altitude authorized for the operator, airplane, and airborne equipment
- Minimum height or altitude permitted by operative airborne equipment and NAVAIDs
- Minimum height or altitude for which required NAVAIDs can be relied upon*
- Minimum height or altitude which provides adequate obstacle clearance*
- Minimum altitude which provides compensation for extremely cold temperatures, if applicable**

***NOTE: Normally addressed by the published instrument approach procedure.**

****NOTE: Applicable only when an operator has a procedure to correct altimeter errors for extremely cold temperatures (Typically less than -22F/-30C) (See table 6.2.10-1).**

b. DA, DH.

(1) Nonprecision Instrument Approaches WITH Vertical Guidance. The DA "altitude" value is measured by a barometric altimeter and is the determining factor for descent minima for all types of approach procedures with VNAV minima. The DH "height" value specified in parenthesis is typically the height of the DA above the Touchdown Zone (TDZ) elevation (Height above Touchdown (HAT)) and does not necessarily reflect actual height above underlying terrain or the height as measured by radio altitude. For procedures with a DA, the DA is specified as a decision altitude referenced to mean sea level (MSL) using QNH altimeter settings. While the (H) element of the DA(H) is typically advisory for such procedures, in certain circumstances the (H) value may be the basis for minima, such as when a QFE-referenced barometric altimeter setting is used.

(2) Category I Instrument Approach Procedures. For a Category I xLS procedure a DA is typically used as the primary approach minima. For Category I operations a decision height (DH) is typically the HAT and does not necessarily reflect actual height above terrain. For procedures with a DA, the DA is specified as a decision altitude referenced to mean sea level (MSL) using QNH altimeter settings. While the (H) element of the DA(H) is typically advisory for such procedures, in

certain circumstances the (H) value may be the basis for minima, such as when a QFE referenced barometric altimeter setting is used. Where a Middle Marker (MM) beacon is installed, it may be used as advisory information, confirming a barometrically determined DA(H) that is coincident with the desired altitude at that point.

(3) Category II Instrument Approach Procedures. For a Category II procedure, a DH specified in terms of an RA value is controlling and any associated barometric altitude value shown in a procedure is considered to be advisory. Procedures that have "Radio Altitude Not Authorized (RA NA)" due to irregular pre-threshold terrain, use the first indication of arrival at the "inner marker" as a means to establish DH. However, an operator may elect to use either the DH or the DA, which ever comes first, as the means for minima determination.

(4) Foreign countries use either a DA or a DH, with a DH-based on a direct specification of DH, or on a corresponding RA value. Other expressions of minima equivalent to a decision altitude (DA) or decision height (DH) may also be encountered, such as when an obstacle clearance altitude (OCA), obstacle clearance height (OCH), or obstacle clearance limit (OCL) is specified, and is to be treated as a corresponding DA or DH. OCA, where used, is referenced to a barometric altitude (MSL). OCH and OCL are referenced to height above either the elevation of the airport, the elevation of the touchdown zone, or the elevation of the landing threshold.

c. MDA, MDH.

(1) For nonprecision instrument approaches WITHOUT vertical guidance, an MDA is specified. Procedures that are <u>not based</u> on use of vertical guidance (e.g., VOR, NDB, LOC BC) use the barometrically based MDA for minima determination. Radio altitude, if provided, is advisory. The MDA represents the minimum altitude in an approach to which descent may continue, until either the required visual reference is established and the airplane is in a position to continue the descent to land using normal maneuvering, or until reaching the specified missed approach point. The MDA(H) "Altitude" value is typically measured by a barometric altimeter, and is the determining factor for these approaches. The "Height" value specified in parenthesis is typically the height of the MDA above the touchdown zone (HAT), and is used only for advisory reference. This height value does not necessarily reflect actual height above underlying terrain or the height as measured by radio altitude. Minima may specify HAT, HAA, MDH, obstacle clearance altitude (OCA), obstacle clearance height (OCH), or obstacle clearance limit (OCL).

NOTE: The use of a MDH is not authorized in the U.S.

(2) Some foreign countries use MDA, HAT, and HAA values based on earlier versions of U.S. TERPS criteria. OCA, OCH, and OCL are used in countries having procedures established IAW ICAO PANS-OPS. Although ICAO PANS-OPS now does not use OCL, some procedures still use OCL criteria from previous versions of PANS-OPS. Some countries, in addition to OCA and OCH, provide MDA and MDH. MDA and OCA are barometric flight altitudes referenced to mean sea level (MSL). HAT, HAA, MDH, OCH, and OCL are radio or radar altitudes referenced to either the elevation of the airport, the elevation of the touchdown zone, or the elevation of the landing threshold. In addition, for international operations, U.S. operators should:

(a) Use an OCA as an MDA.

(b) Use an OCH, OCL, or HAT as an MDH for "straight-in" approach procedures.

(c) Use an OCH, OCL, or HAA as an MDH for "circling" approach maneuvers.

4.2.6. Specification of Category II Minima.

a. Description of Category II operations and minima indicate the lowest authorized DH for Category II is cited in this paragraph as an equivalent DH related to wheel height above touchdown zone elevation (e.g., HAT value of 100 ft.). DH for a Category II procedure is established by the following nominal conditions:

(1) The airplane’s navigation reference point tracks the center line of the glide path and FAS;

(2) Standard wheel to navigation reference point height and distance assumptions are used;

(3) A 100 ft. or 150 ft. airplane HAT is assumed for the landing airplane at DH, depending on minima to be specified; and

(4) A determination is made of the actual radio altitude above underlying terrain that occurs when an airplane with nominal wheel to navigation reference height reaches the point on approach where the airplane first reaches 100 ft. HAT.

b. Alternately, a Category II DH may be set based on specifying use of a 100 ft. DH above underlying terrain, regardless of circumstance, in which the 100 ft. above terrain point is reached. In this instance, the first point of time in which any airplane, with any arbitrary wheel to navigation reference height, pitch attitude, configuration, lateral displacement, or speed, first reaches the point at which 100 ft. radio altitude is indicated above underlying terrain, the airplane is considered to have reached DH.

4.2.7. Circling Approaches. Many instrument procedures provide for circling approach minima. Sufficient visual references for manually maneuvering the airplane to a landing must be maintained throughout a circling maneuver. The pilot must keep the airplane's position within the established maneuvering area while performing the circling maneuver. The circling MDA (HAA) or equivalent must be maintained until an airplane is in a position from which a normal descent can be made to touchdown within the touchdown zone, using normal maneuvers and a safe descent path. For additional information, see paragraph 4.2.21.

4.2.8. Reduced RVR Minima for Category I and Category II Instrument Approaches. Based upon the use of autoland, or HGS equipment, the operator may request and the CMO may authorize use of certain reduced RVR minima for Category I and II instrument approaches. FAA Order 8400-13, Procedures for the Approval of Category II Operations and Lower than Standard Category I Operations, provides specific guidance on the limits of this reduction and the criteria to be met in order to receive the authority.

4.2.9. Visibility and RVR Minima. Visibility minima are as specified in Instrument Approach Procedures approved for use by the operator, or as otherwise listed in standard OpSpecs applicable to that operator for Nonprecision, Category I, or II landing. Operating minimums may be expressed as meteorological visibility (VIS), runway visual range (RVR), or runway visibility values (RVV).

a. Meteorological Visibility (VIS). In the U.S. meteorological visibility may be used as reported by the FAA, by the NWS, a source approved by the NWS, or a source approved by the FAA.

(1) Outside of the U.S., meteorological reporting sources may be approved for operators by the FAA. Visibility determination may vary, and the operator should ensure that the meaning, definition, and significance of any meteorological visibility reported for use in determining minima is understood by that operator's pilots.

(2) For approval, operators should consult their respective Certificate Management Office (CMO), Certificate Management Unit (CMU), or Principal Operations Inspector (POI). FAA Flight Standards District Offices (FSDO), CMO's, or CMU's that need assistance in responding to operator inquiries regarding approval of weather sources that are not addressed by current directives (e.g., FAA Order 8400.10) should consult AFS-400.

b. Runway Visual Range (RVR). RVR is considered to be an instrumentally derived value measured by transmissometers. RVR is calibrated by reference to runway lights and/or the contrast of objects.

(1) Controlling RVR means the reported values of one or more RVR reporting locations (TDZ, Mid, Rollout, or equivalent international locations) used to determine whether operating minima are or are not met, for the purpose of approach initiation, or in some cases, approach continuation.

(2) All U.S. Category I operating minimums below 1/2 statute mile (RVR2400) and all Category II and III operating minimums are based on RVR.

(3) Where RVR is used, the controlling RVR for Category I minima is touchdown RVR. All other readings are advisory.

(4) For Category II minima, controlling RVR is as specified by OpSpecs.

(5) RVR is a value which typically only has meaning for the portions of the runway associated with the RVR report (TDZ, MID, or Rollout). RVR is a value that may vary with runway light step settings (1 through 5). Operators should ensure that pilots are familiar with runway light setting effects on reported RVR. RVR values may not be representative of actual visibility along portions of the runway due to the location of the transmissometers or due to variable conditions of fog, blowing snow, or other obscurations along the runway, or due to obscurations varying rapidly in time (e.g., patchy fog). Additionally, newer RVR systems may have localized performance sensitivity since they do not use a baseline along the runway (e.g., a forward scatter array may be used for visibility assessment). Thus, pilots and operators should note that RVR has operationally significant limitations and can be greater than or less than the actual visibility available to a pilot at the runway. This is particularly true at night, if runway lights are not at settings standard for the prevailing conditions, or if unusual daylight conditions are experienced such as when a runway is aligned with a sunrise or sunset condition, in shallow or patchy fog.

(6) Outside the U.S., some RVR reports may not be instrumentally derived by transmissometers or forward scatter meters and may be made by pilots or other weather observers. Accordingly, operators should understand and ensure the meaning, definition, significance, and variability of any non-instrumentally derived value of RVR reported to the pilot for use in determining minima are understood by the pilot and his/her operator.

c. Runway Visibility Values (RVV). RVV minima are now used infrequently, are being phased out, and should be used only where minima cannot otherwise be specified as a meteorological visibility (VIS) or runway visual range (RVR).

4.2.10. Visibility Assessment and RVR Equivalence for Landing.

a. For instrument procedures where minima are expressed in terms of meteorological visibility, but the value reported to the flightcrew is an RVR, tables referenced in standard OpSpecs may be used to establish equivalent meteorological visibility minima (see OpSpecs paragraph C051).

b. Where minima available to the flightcrew is expressed only in terms of RVR, but the value reported to the flightcrew is a meteorological visibility, the "Visibility-RVR Equivalence" table, referenced in OpSpecs, may be used to establish an equivalent RVR value (see OpSpec paragraph C051). Use of this provision, however, specifically requires FAA authorization in addition to issuance of paragraph C051, and should be limited by the POI or CMO to only those operators and locations outside of the U.S. that have a need to use the "visibility-RVR" equivalence table for this type of determination.

4.2.11. FAA Flight Inspection Analysis and Verification of All Instrument Procedures. All Nonprecision and precision instrument approach procedures require flight inspection prior to operational approval. Flight inspections will be conducted in accordance with FAA Order 8200.1, United States Standard Flight Inspection Manual. This process includes signal-in-space validation of the navigation and landing aids supporting the procedure and procedure design criteria. Procedures will be evaluated throughout all segments and include required fixes and waypoints. Procedures requiring special equipment may require use of the operator's airplane with flight inspection personnel monitoring from the flight deck.

a. Navigation and Landing Aids. All ground-based navigation and landing aids are initially flight inspected prior to commissioning and revalidated on a scheduled periodic basis. These inspections measure and analyze various signal-in-space parameters (accuracy, coverage, etc.) and validate all fail-safe monitoring parameters. Flight inspection airplanes are equipped with an independent truth system that allows post-processing of measured data to remove Flight Technical Error and expose Navigation System Error. The inspection results are recorded and archived.

b. Instrument Approach Procedure Design. Each instrument approach procedure is evaluated to ensure:

(1) Airplane maneuvering is consistent with safe operating practices for the category of airplane intending to use the procedure.

(2) Crew workload (human factors) is acceptable.

(3) Navigation charts properly portray the procedure and are easily interpreted.

(4) Navigation database information is accurate.

(5) Runway marking, lighting, and communications are adequate.

(6) Verification of obstructions and obstacle clearance.

(7) Supporting navigation aids provide the required signal coverage throughout the procedure.

4.2.12. General Requirements for Nonprecision and Category I Operations. The following general requirements apply to the operational authorization of Nonprecision and Category I instrument approach procedures:

a. The airborne system(s) should meet the requirements of the applicable paragraphs of paragraph 5.2 for the type of instrument approach procedure to be flown;

b. Appropriate NAVAIDs and airport/lighting facilities for the instrument approach procedure to be flown must be available, consistent with paragraph 8;

c. Flightcrew qualification must be completed in accordance with applicable regulations and the operator's FAA approved training program;

d. An acceptable airworthiness (maintenance) program for the airborne system is provided IAW paragraph 9; and

e. An operational authorization must be completed IAW paragraph 10 for a U.S. operator or paragraph 11 for a Foreign operator.

4.2.13. Category I Operations.

4.2.13.1. "xLS" Procedures - Minima not less than 200 ft. HAT. Instrument approach operations that may be authorized **Category I** minima not less than **200 ft. HAT** include at least the following:

a. ILS

b. GLS (i.e., SBAS/Ground Based Augmentation System (GBAS))

c. MLS

d. Special Procedures - Special procedures having individual FAA approval for each operator or location, that are capable of supporting a DA(H) down to at least 200 ft. HAT may be authorized (e.g., PAR, GLS SCAT I). Such special procedures typically require associated conditions or limitations for special flightcrew training, for navigation facility use coordination, site-specific suitability review, or operator or other agency monitoring (e.g., as for DOD provision of PAR capability).

4.2.14. Nonprecision Operations.

4.2.14.1. RNAV Procedures with VNAV - Minima not less than 250 ft. HAT. Instrument approach operations that may be authorized minima not less than **250 ft. HAT** include:

a. NAVAID specific procedures flown using RNAV lateral and vertical guidance (e.g., "VOR Rwy 16R" flown using acceptable LNAV and VNAV) such as a VOR, VOR/DME, NDB, Localizer or Localizer Back Course approach flown using RNAV, when the procedural identified NAVAID(s) are referenced in the FMS position determination, or when the procedure is flown with the flightcrew monitoring the specified facility(s) by instrument display cross reference (e.g., RDMI situation information display, or equivalent); and

b. RNAV Procedures overlaying a NAVAID specific procedure, when FMS position updating is referenced to "data base procedural tuning" of the specified facility(s) (e.g., "RNAV or VOR Rwy 16R" flown using acceptable LNAV and VNAV, with FMS using the appropriate procedurally identified NAVAID(s) along with any other applicable sensors for position determination).

4.2.14.2. "2D" RNAV Procedures (e.g., VOR/DME based RNAV, or GPS based RNAV) - Minima not less than 250 ft. HAT. Instrument approach operations in this group may be authorized minima of not less than **250 ft. HAT.**

a. This group includes at least the following:

- 2D RNAV based on sensor inputs from GPS
- 2D RNAV based on sensor inputs from DME/DME
- 2D RNAV based on sensor inputs from VOR/DME
- 2D RNAV based on sensor inputs from combinations of LOC and VOR or DME

b. Other FAA authorized RNAV based approach procedures (e.g., Loran, Airborne radar).

4.2.14.3. Procedures Other than RNAV (e.g., VOR, NDB, LOC, Back Course LOC, or ASR Procedures) - Minima not less than 250 ft. HAT. Instrument approach operations in this group include**:**

a. ICAO or U.S. NAVAID specific procedures other than those based on xLS or RNAV, and including at least the following:

- Localizer (LOC)
- Localizer Back Course (BC)
- SDF
- LDA
- VOR
- VOR/DME
- NDB
- Dual NDB
- NDB/DME
- TACAN

b. NAVAID specific procedures as listed in item a above, but when flown with vertical guidance (e.g., using VNAV);

c. NAVAID specific procedures as listed in item a above, but when flown with an "open loop" vertical speed based descent profile; and

d. Radar Surveillance Approach Procedures including ASR.

4.2.15. Other Special Procedures or Authorizations. Other special procedures or authorizations may be issued as follows:

a. Special Authorization to use a 200 ft. HAT based on an assessment of the runway touchdown zone region and operator use of HGS or auto flight guidance systems may be issued for a particular runway, operator, or a group of operators (e.g., KDTW R/W21R)(See HBAT 94-12).

b. Airborne Radar Approach authorizations may be issued to qualified applicants for use with qualified airborne systems.

c. Special Limited Use (Non-ICAO) Procedures (e.g., TLS, KRM).

4.2.16. Previously Approved Nonprecision or Category I Operations. Operators approved IAW criteria of earlier versions of AC 120-29 for Nonprecision or Category I, or operating IAW approved OpSpecs for instrument approaches other than ILS, MLS, or GLS may continue to operate IAW their previously approved program, consistent with current standard OpSpecs or any special provisions approved for that operator in that operators approved OpSpecs.

a. Approval criteria used for a particular airplane are typically listed in an AFM. If not shown in an AFM, the applicable FAA Aircraft Evaluation Group (AEG) may be consulted through the POI or CMO, to determine eligibility.

b. Airplanes qualified using other than FAA criteria will be as designated in approved OpSpecs or as designated by the applicable AEG (e.g., through the FAA Flight Standardization Board Report for the airplane type) or AFS-400.

4.2.17. General Requirements for Category II.

4.2.17.1 General Criteria. The following requirements apply to the operational authorization of Category II instrument approach procedures:

a. The airborne system should meet the requirements of paragraph 5.3 for the type of Category II procedures to be flown;

b. Appropriate NAVAIDs and airport/lighting facilities for the procedures to be flown, consistent with paragraph 8, are used;

c. Flightcrew qualification has been completed in accordance with applicable regulations and the operator's FAA approved training program;

d. An acceptable airworthiness (maintenance) program for the airborne system is provided IAW paragraph 9; and

e. An operational authorization has been completed per paragraph 10 for a U.S. operator or paragraph 11 for a Foreign operator.

4.2.17.2. Eligibility for Category II Minima not less than 100 ft. DA(H). Instrument approach operations that may be authorized Category II minima not less than 100 ft. DA(H) include:

a. ILS;

b. GLS (GBAS/Local Area Augmentations System (LAAS)); and

c. MLS.

4.2.17.3. Use of Inner Marker (IM). Use of Inner Marker may be authorized in lieu of a DH. An Inner Marker is typically used at runways designated by the applicable procedure, such as where radar altimeter use is limited due to irregular pre-threshold terrain (e.g., RA NA).

4.2.17.4. Barometric Altimeter DA's Used for Category II. Barometric altimeter specified DAs are not currently used as a basis for minima for Category II operations. However, operators may elect to discontinue an approach upon reaching either the DA or DH, which ever is reached first, when visual reference is not established; or upon reaching either the DA or Inner Marker (IM), which ever is reached first, when the IM is the basis for Category II minima.

4.2.17.5. Category II on U.S. Type I ILS. Category II operations on Type I ILS ground facilities are limited to specified locations for qualified flight guidance systems. Criteria for air carriers to conduct Category II operations on certain Type I ILS ground facilities are contained in FAA Order 8400.13.

4.2.17.6. Category II Using 1000 Feet RVR (300 "Meter") Minima. Category II operations using 1000 RVR (300m) minima may be authorized when the provisions of OpSpecs paragraph C359 are met. For use of this provision where such operations are authorized by the State of the Aerodrome (e.g., certain European airports), FAA considers the operation to be the equivalent of a U.S. Category III operation (RVR1000), even though the State may locally classify it to be a Category II operation. This provision permits an operator to be authorized minima of RVR300m with a DA(H) of 100 ft. HAT at certain U.S. and foreign airport runways qualifying for a minima less than that specified by U.S. and ICAO for Category II operations. A flight guidance system meeting provisions of OpSpecs paragraph C359c, is required and corresponding flightcrew procedures must be used. In addition, the operator shall ensure that:

- the Type II ground facility is flight inspected and maintained as a Type III ground facility, and
- when NOTAMed, if the Type III ground facility is downgraded to a Type II facility, the flightcrews are notified of this affect on their operation.

4.2.17.7. Precision Approach Radar (PAR). Precision Approach Radar minima may be authorized to not less than 200 ft. HAT, or the published PAR minima, whichever is higher. PAR authorizations are limited to those operators and flightcrews specifically qualified to use PAR. Request for PAR operations with minima below 200 ft. HAT are approved only on a case by case basis, considering any special flightcrew qualification required, the airplane type and its characteristics (e.g., airplane size, airplane geometry, and PAR radar signature), and the specific facilities to be used.

4.2.17.8. Previously Approved Category II Operations. Operators approved IAW earlier versions of AC 120-29 for Category II may continue to operate IAW their previously approved program, consistent with current standard OpSpecs or any special provisions approved for that operator in that operators approved OpSpecs.

a. Approval criteria used for a particular airplane are typically listed in an AFM. If not shown in an AFM, the applicable FAA AEG may be consulted through the POI or CMO, to determine eligibility.

b. Airplanes qualified using other than FAA criteria will be as designated in approved OpSpecs or as designated by the applicable AEG (e.g., through the FAA Flight Standardization Board Report for the airplane type) or AFS-400.

4.2.18. Runway Field Length Requirements and Runway Contamination. Nonprecision, Category I, or II landing distance requirements are specified by 14 CFR part 121, sections 121.185, 121.187, 121.195 or 121.197.

a. The following means of complying with the above provisions of part 121 are considered to be acceptable. Examples are provided for turbine airplanes. Airplanes other than turbine powered airplanes, or airplanes operating under 14 CFR parts other than part 121, may apply equivalent provisions in a similar manner.

b. Part 121 turbine airplane operations must meet provisions of section 121.195(b). Normally these landing distances (e.g., that already include the specified 60 percent factor) are factored into the AFM data provided for landing distance. Otherwise, they have to be added to the AFM.

c. If it is determined during dispatch, in weather forecasts, or reports, that the landing runway may be wet (e.g., may be considered to include "chance," "occasional," "temporary," or a probability equal to or greater than 10 percent), the effective runway length must be at least 115 percent (i.e., IAW section 121.195(d)) of the distance determined under section 121.195 (b).

d. Unless otherwise authorized by FAA, wet is considered to be any condition "not clear and dry" on any part of the useable area of the runway (useable area does not include edges, sides, melting of ice or snow banks at edges or sides, area beyond the advertised plowed and sanded surface, overruns, etc.).

> **NOTE 1: FAA may authorize a wet grooved runway with good braking friction characteristics, or equivalent, to be considered a dry runway for purposes of dispatch determination. A wet runway is considered to be a runway that is other than clear and dry, and has no standing water.**
>
> **NOTE 2: Airplanes for which a special demonstration has been made for stopping distance on a wet runway for compliance with section 121.195(d) may use information from this determination for low visibility landing distance assessment (see AC 121.195-1A, Operational Landing Distances for Wet Runways; Transport Category Airplanes).**

e. If any useable part of the expected landing runway or runways are slippery (e.g., wet and not-grooved or porous friction coarse (PFC), snow, slush, ice, or standing water) the provisions of section 121.195(d) apply. In addition, operators should consider the possible need for extra stopping distance beyond that required by section 121.195(d), if braking action is reported or expected to be worse than "good." The amount of additional stopping distance, if any is determined by the operator to be appropriate, may be related to any estimated reduction in stopping capability for the assumed conditions (see FSAT 96-03, Runway Friction Reports and Advisories).

f. Information on autobrake distance provided by the manufacturer may be used as the basis for Nonprecision, Category I or Category II field length determinations. If AFM autobrake data is used as the basis for determining acceptable landing distance, the operator should ensure that appropriate factors for use of autobrakes are considered, and if appropriate, accounted for (e.g., brake configuration, autobrake setting(s), runway surface friction, and runway slope). If a dispatch process applies, dispatch should consider, and provide any necessary information to the flightcrew regarding any pertinent "autobrake settings" on which dispatch may be based. If autobrakes are to be used, it is not necessary to additionally factor autobrake stopping distance data by the 115 percent specified in section 121.195(d) beyond the stopping distance otherwise protected by section 121.195(d). However, if expected stopping distance based on using an autobrake system, or any particular setting(s) of an autobrake system, is greater than that protected by section 121.195(d), then the operator should take that fact into consideration and provide appropriate stopping distance information or stopping procedures to the flightcrew.

g. When an operator needs to provide for an instrument approach and low visibility landing following an emergency return after take-off, or when using a take-off alternate, the operator should consider the expected landing configuration, braking method, and initial braking speeds in assessing landing field length requirements (e.g., consider landing weight, engine out flap settings, engine inoperative speeds as applicable, potential for partial brakes, or partial antiskid, or inoperative reverse thrust).

h. When determining alternate airport field length provisions (e.g., sections 121.187 or 121.197, as applicable) it is recommended that the operator consider the weights, flap settings, and approach speeds that may be applicable to use of that alternate airport with an engine inoperative. Approval for use of an alternate airport based on "Engine Inoperative Category II" capability, requires the operator to consider such representative speeds, as applicable to the engine inoperative configuration, in assessment of the required landing distance.

i. The following field length factors and considerations are considered acceptable:

(1) Nonprecision and Category I Field Lengths.

(a) For minima or conditions expected to be at or above RVR3000, the runway field-length requirement for Nonprecision and Category I is as specified by section 121.195 for either a dry or wet runway. For minima or conditions expected to be below 3000RVR the field length requirement should be based on conditions for a wet runway (section 121.195(d)).

(b) Field length requirements are determined based on applicable weather reports and forecasts considered at the time of dispatch or release (i.e., section 121.195 reference to "take-off"). Once an airplane is enroute, it is recommended that field length requirements be reassessed if conditions significantly change from the conditions on which the departure was based.

(2) Category II Field Lengths.

(a) The Runway Field-Length Requirement for Category II is as specified by section 121.195(d) for a wet runway.

(b) When auto brake systems are used for Category II, information must be available to the flightcrew to assist in making the proper selection of a suitable auto brake setting consistent with the field length available for landing and the runway condition, including braking action.

(c) Category II operations should not normally be conducted with braking action less than "fair" unless the operator has a method to ensure that timely updates of field conditions are provided to the flightcrew, and if applicable also provided to the dispatcher, and that the flightcrew considers that sufficient runway length is available for the landing in the conditions reported.

(3) Runway Field Length Airborne Considerations. Runway field length requirements are typically considered to be dispatch or release (pre-departure) requirements rather than "in-flight" assessment requirements. In the event of unforecast adverse weather enroute, or if braking system or other failures affecting stopping performance occur enroute, the flightcrew should consider any adverse landing distance consequences that may result from a decision to make a landing on a particular runway

(e.g., braking action reports, contamination).

4.2.19. Navigation Aids (NAVAIDs) and System Sensors. Various system sensors or combinations of sensors may be used to provide position fixing capability. Certain sensors are primarily used for landing operations. The sensors described here may also be used for takeoff, missed approach, or other operations. Regardless of the sensors, NAVAIDs, or combination of NAVAIDs used, they must provide coverage for the intended flight path and for displacements from that flight path.

4.2.19.1. Instrument Landing System (ILS). The ILS provides a reference signal typically aligned with the runway centerline and deviation signals when the airplane is displaced left or right of the extended runway centerline. The linear coverage area for this signal is approximately 3 degrees either side of the extended runway centerline from a point emanating at the far end of the runway. The ILS also provides a vertical flight path (nominally 3 degree descent angle) to a point in the landing zone of the runway. The vertical coverage is approximately 0.7 degrees on either side of the vertical reference path. ILS characteristics are defined in ICAO Annex 10, unless otherwise specified by FAA. ILS systems are classified by Type as defined in ICAO Annex 10 and FAA Order 6750.24, Instrument Landing System and Ancillary Electronic Component Configuration and Performance Requirements (e.g., II/D/2).

4.2.19.2. Microwave Landing System (MLS). The MLS provides a reference signal typically aligned with the runway centerline and deviation signals when the airplane is left or right of the extended runway centerline. The linear coverage area is approximately 40 degrees either side of the extended runway centerline emanating from a point at the far end of the runway. The MLS provides a vertical flight path to the runway similar to ILS. MLS characteristics are defined in ICAO Annex 10, unless otherwise specified by FAA. MLS systems are classified by Type, similar to ILS.

4.2.19.3. GNSS Landing System (GLS). GLS is based upon Global Navigation Satellite Systems (GNSS). The performance classification of GLS may differ for each runway end served (e.g., III/E/3 for Runways 14L and 14R, but I/D/1 for RW 22L). Desired path, centerline, and deviation signals as applicable, are computed by airborne avionics. GLS provides both vertical and lateral flight path guidance to the runway touchdown zone and a lateral path for rollout or takeoff. GLS characteristics are defined in ICAO Annex 10, unless otherwise specified by FAA. GLS systems are classified by Type, similar to ILS. Authorization for use of GLS is specific for each air carrier, aircraft type, and GLS system type.

4.2.19.4. Satellite Systems. Navigation Satellite systems currently consist of the United States Global Position System (GPS) and the Russian Federation Global Navigation Satellite System (GLONASS). Various forms of augmentation exist or are in development including Space Based Augmentation Systems (SBAS), Ground Based Augmentation Systems (GBAS), and Aircraft Based Augmentation Systems (ABAS). These augmentation systems may also be classified as wide area (e.g., EGNOS, WAAS) or local area augmentation systems (e.g., DGPS, LAAS). GNSS is combined with certain augmentation systems (e.g., LAAS) to provide a GNSS based Landing System (GLS).

4.2.19.4.1. Local Area Systems. Ground Based Augmentation Systems (GBAS) include the FAA’s Local Area Augmentation System (LAAS) and non-federally provided systems (e.g., SCAT I). These landing systems include a differential reference station in the vicinity of the runway for Category I or Category II instrument approach procedures. These stations may serve one or more runways and nearby airports. The coverage area for a LAAS reference station is typically a 20 nautical mile radius.

4.2.19.4.2. Wide Area Systems. Space Based Augmentation Systems (SBAS) include the FAA’s Wide Area Augmentation System (WAAS) and other internationally accepted systems (e.g., EGNOS). Procedures based on any form of SBAS alone or SBAS in multi-sensor systems such as FMS are identified as "RNAV" procedures.

4.2.20. Use of Navigation Aids (NAVAIDs) and System Sensors.

a. ILS. A precision instrument approach system which normally consists of a localizer, glide slope, outer marker, middle marker, and approach light system.

b. MLS. A precision instrument approach system operating in the microwave spectrum which normally consists of an azimuth station, elevation station, and precision distance measuring equipment.

c. GLS. A differential GPS or GNSS (e.g., WAAS, LAAS, SCAT 1) based landing system providing both vertical and lateral position fixing capability.

4.2.20.1 LOC/LDA/SDF/Back Course. Localizer, Localizer Descent Aid (LDA), Simplified Directional Facility (SDF), or

Back Course ILS (BC) based procedures are authorized to minima not less than 250' HAT.

4.2.20.2 VOR. VOR or VOR/DME instrument approach procedures support minima not less than 250' HAT.

a. VOR or VOR/DME instrument approach procedures may be flown using acceptable flight instrument displays such as:

- EHSI or ND Map display
- EHSI or ND situation information display (e.g., EHSI lateral deviation display or VOR needle(s))
- Electromechanical HSI display
- RMI, RDMI, or equivalent display, or
- Situation information lateral deviation display (e.g., cross pointer display)

b. VOR instrument approach procedures (IAPs) flown without vertical guidance (e.g., without VNAV), use an MDA.

c. VOR IAPs flown with approved vertical guidance (e.g., with VNAV), may use either an MDA or a DA(H), as determined to be suitable for the procedures.

d. The aircraft navigation system and flight instrument system display(s) used must be acceptable to the POI, considering that operator's routes, procedures, crew qualification, training, and recency of experience policies or programs.

4.2.20.3. DME. When used in conjunction with VOR, NDB, LOC, LDA, SDF, or LOC BC (e.g., VOR/DME), DME is authorized for air carrier use and may be authorized to minima not less than 250' HAT.

a. When used in conjunction with ILS or MLS, DME along track fixes may be used with Category I, II, or III procedures, as identified in the procedure.

b. DME along track fixes may be substituted for any marker beacon, VOR, NDB, or Compass Locator on any segment of an ILS or MLS procedure where the corresponding DME value is procedurally specified except for Category II or III procedures identified by FAA as requiring use of an Inner Marker.

4.2.20.4. NDB.

a. Authorized procedures. NDB instrument approach procedures, when based on NDB alone, when based on multiple NDBs, or when specified in conjunction with use of DME are authorized for air carrier use, and may be authorized to minima not less than 250' HAT.

(1) NDB, NDB/NDB, or NDB/DME based procedures may be flown using an appropriate EHSI or ND Map Display, EHSI or ND Situation information display, Electromechanical HSI, RMI, RDMI, or ADF display for course guidance, as determined acceptable to the POI considering the crew qualification, training, and recency of experience applicable to that operator.

(2) NDB procedures, when flown as a procedure without vertical guidance (e.g., without VNAV), use an MDA.

(3) NDB procedures, when flown as a procedure with approved vertical guidance (e.g., with VNAV), may use a DA(H).

b. Use of a single NDB/ADF airborne system. Other than following an in-flight failure of one of several installed airborne systems NDB/ADF receivers, instrument procedures based on NDB/ADF may be flown using a single airborne NDB/ADF receiver in lieu of two airborne NDB/ADF receivers (section 121.349) under the following conditions:

(1) The operator is authorized to conduct procedures using a single airborne NDB/ADF receiver, and

NOTE: Authorization for use of a single NDB/ADF may be for a specific instrument procedure, a group of instrument procedures, for an operator's particular fleet of aircraft (e.g., B727 fleet), for all of an operator's aircraft, or for a geographic region (e.g., within the U.S. and U.S. territories), as applicable to the operator's route structure and fleet.

(2) Instrument procedures requiring simultaneous use of more than one NDB/ADF NAVAID facility are not authorized, and

(3) In the event of failure of the airborne NDB/ADF receiver, or other essential element of the airborne NDB/ADF navigation or display system, the approach can be safely discontinued at any point during the approach to touchdown, or at any time during a missed approach, and

(4) Following initiation of the missed approach or balked landing, a transition can be made to use some other NAVAID or NAVAIDs to complete a safe missed approach and subsequent flight to an alternate airport.

NOTE: Suitable navigation performance should be achievable to safely complete the missed approach, fly to the alternate, and complete a subsequent approach using a different navigation system or NAVAID, without loss of knowledge of position, loss of appropriate obstacle clearance, or loss of terrain clearance.

4.2.20.5. Radar Systems (e.g., PAR, ASR). Various other systems are in limited use (e.g., PAR, ASR). These systems are considered for air carrier operations only as described below.

a. Air carrier approach operations using ASR or PAR may only be approved if OpSpecs contain authority for their use.

b. For use of ASR, dedicated training is not specifically required unless the POI determines that the operators general training and qualification program is not otherwise satisfactory for routine use of ASR procedures, and that specific ASR training is needed.

c. For use of PAR, dedicated PAR training is appropriate unless the POI determines that the operator's training and qualification program is otherwise able to assure adequate crew preparation so that dedicated PAR/GCA training or demonstration is not needed.

4.2.20.6. Other Systems, Procedures, and Special Systems.

a. Marker Beacons. 75 MHz marker beacons are used in the NAS or internationally as part of ILS, and for other limited or special applications (e.g., step-down fixes, departure turn points for instrument departures when flying the associated localizer). Use of marker beacons does not require dedicated crew training or qualification beyond that of ILS approaches.

b. Airborne Radar Approach. Operational authorization for the use of any "airborne radar approach" procedure (e.g., use of ground mapping radar or equivalent) to conduct an instrument approach requires coordination with the FAA (AFS-400), and may require proof of concept demonstration acceptable to FAA.

c. KRM, RMS, SRE or other unique systems or procedures which are not necessarily used in accordance with ICAO criteria (e.g., as used in parts of Europe) may only be approved for use by an air carrier if the aircraft is suitably equipped to receive and use the specified system and that system can meet the performance, integrity, and availability standards equivalent to those established for currently approved U.S. operations (e.g., ILS, LDA, ASR, RNAV using FMS). Minima authorized should not be less than any corresponding minima applicable to an equivalent U.S. procedure. If not an ICAO standard NAVAID, operational authorization for use of such systems should include coordination with the State of the aerodrome and with the FAA (AFS-400), and may require review and demonstration to the FAA (e.g., to a POI, APM or CMO).

d. Transponder Landing System. Transponder Landing System or other such "multi-lateration" systems may only be approved for an operator if the system can meet the performance, integrity, and availability standards equivalent to those established for currently approved types of operations (ILS), to corresponding minima. Operational authorization of use of any of these systems must be acceptable to FAA (for further information, see Order 8400.TLS).

e. Enhanced Vision Systems (EVS) are intended to provide the flightcrew with a visual presentation of a view of the approach to a runway that may otherwise be obscured by weather or darkness. Operational authorization for use of enhanced vision systems requires successful completion of a proof of concept demonstration acceptable to FAA.

4.2.21. Circling Approaches. When instrument approach design criteria or operational factors do not permit a "straight-in" approach to the landing runway, circling instrument approach procedures may be used. U.S. criteria require SIAP publication of circling minima if the inbound course is offset more than 30 degrees from the runway centerline (15 degrees for RNAV), or when a specified descent gradient for a straight-in approach is steeper than a maximum value allowed by instrument procedure design criteria. For additional information, see paragraph 4.2.7.

a. Use of circling minima, however, does not preclude a pilot making a straight in landing if the requirements of 14 CFR part 91, section 91.175 (adequate visual reference and for normal landing maneuvering) can be continuously met below DA(H) or MDA to touchdown. Typically, circling approaches are based only on an MDA. Use of a DA(H), for circling, is addressed because certain procedures using a DA(H) may apply to "sidestep" maneuvers, or may be used with very high values of DA (H), such as in mountainous areas that otherwise may require a circling maneuver to position to land after reaching minimums.

b. The circling maneuver can be initiated from any instrument approach procedure where circling is authorized, and may be continued below DA(H) or MDA or beyond the missed approach point (MAP) only when the specified visual reference exists, and when in a position for a normal descent to landing. Electronic course or glidepath information, or FMS flight path presentations are only considered supplementary information to visually accomplishing the circling maneuver. The pilot must keep the aircraft's position within the established maneuvering area for the approach speed and category specified for the procedure while performing the circling maneuver. An altitude at or above the circling MDA must be maintained until an aircraft (using normal maneuvers) is in a position from which a normal descent can be made to touchdown within the touchdown zone. A missed approach must be executed if external visual references are lost or sufficient visual cues to manually maneuver the aircraft cannot be maintained.

c. It is important to note that the published missed approach procedure may not provide obstacle clearance when below DA (H) or MDA, or when past the published missed approach point (MAP). If it is necessary to conduct a missed approach from below the DA(H) or MDA or after passing the MAP (e.g., as a result of a balked landing, rejected landing, loss of visual reference, not in a safe position to land, blocked runway, or other similar reason for a go-around), reference to the associated IFR departure procedure for the applicable runway(s) may provide information to assist the pilot in determining a safe course for returning to the procedurally protected airspace (adequate obstacle clearance) of the published missed approach procedure.

d. When a missed approach from a circling maneuver is executed from below a DA(H) or MDA such as when visual reference is lost after passing the DA(H) or MDA, or when initiating the missed approach from beyond the missed approach point such as when not able to maneuver to be able to accomplish a normal landing in the touchdown zone, the direction of the initial missed approach turn should typically be in a direction toward the landing runway, to assure obstacle clearance. This will aid in keeping the aircraft within the maneuvering area while climbing to intercept a published segment of the missed approach procedure. Pilots should be aware of the applicable radius of protected airspace for the respective approach category used for the circling maneuver, and maneuver the aircraft visually within that protected airspace radius from the airport until established on the missed approach procedure.

e. Operators may be authorized to perform circling approaches as published, or may choose to not train flight crews to accomplish circling maneuvers, and accept corresponding high minima limitations regarding circling approaches. If an operator chooses to not train for circling approaches, see HBAT 01-03, Circling Instrument Approach Procedures; OpSpec C075 Revision.

4.3. RNAV/Flight Management Systems (FMS).

a. An RNAV system or FMS provides a means to navigate along a flight path based upon earth referenced waypoints. These waypoints can define a flight path that originates or terminates at a runway, or at other relevant fixes located in terminal or en route airspace. This type of system may be approved for approach and missed approach operations IAW the standards in this AC and standard OpSpecs.

b. Flight Management Systems (FMS) must meet criteria of AC 25-15, Approval of Flight Management Systems in Transport Category Airplanes, AC 20-129, Airworthiness Approval of Vertical Navigation (VNAV) Systems for use in the U.S. NAS and Alaska, and AC 20-130, Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors, or criteria acceptable to the FAA (e.g., those systems previously shown to meet AC 90-45 which predated the above references, and have subsequently been determined to be capable of meeting essential elements of the above criteria).

4.3.1. FMS Use for xLS Instrument Approach Procedures. ILS, MLS, or GLS instrument approach or procedures are typically flown with FMS only to the extent that the FMS:

- May be used to display the ILS, MLS, or GLS procedure (e.g., as on a navigation map display)
- May be used to tune appropriate ILS, MLS, or GLS NAVAIDs or radio frequencies
- May be used to define, display and fly various LNAV or VNAV segments to intercept the final approach path or segment, or glideslope
- May be used to define, display and fly various LNAV or VNAV segments for a missed approach path

4.3.2. FMS Use for Instrument Approach Procedures Other Than xLS or RNAV. Systems incorporating GNSS may be used to conduct VOR, VOR/DME, NDB, and NDB/DME instrument approaches. Systems not incorporating GNSS may be used to conduct the above operations and LOC and LOC Back Course instrument approaches by monitoring the underlying NAVAID, or as specified in the AFM.

4.3.3. FMS Use for RNAV Instrument Procedures. FMS may be used as a 2D or 3D RNAV system, to conduct RNAV instrument approaches.

a. RNAV procedures are designed, based on one or more NAVAIDs (e.g., the FMS data base identifies specific VOR/DME NAVAIDs).

b. GPS approaches are considered to be RNAV approaches when flown by an FMS. GPS approaches may only be flown by those FMS systems which are capable of suitable GPS position updating and have appropriate navigation data base information to properly load and display the procedure to the flightcrew. Some GPS approaches are not suitable for use with FMS because of procedure design, vertical path definition, an inability to "call up" or "load" the procedure from a data base, because the FMS may not be able to appropriately recognize GPS as a type of approach classification, or because the airplane AFM may not suitably provide for GPS procedure use. Operators intending to fly GPS approaches using FMS should treat such procedures as Nonprecision procedures, and ensure that the FMS can properly fly each procedure.

c. Use of a single RNAV system. Other than following an in-flight failure of one of several installed airborne RNAV systems (e.g., failure of one FMS), instrument procedures based on RNAV may be flown using a single airborne RNAV system in lieu of two RNAV systems under the following conditions:

(1) The operator is authorized to conduct instrument procedures using a single RNAV (FMS) system, and

NOTE: Authorization for use of a single RNAV may be for a specific instrument procedure, a group of instrument procedures, for an operator's particular fleet of aircraft (e.g., B737 fleet), for all of an operator's aircraft, or for a geographic region (e.g., within the U.S. and U.S. territories), as applicable to the operator's route structure and fleet.

(2) Instrument procedures requiring simultaneous use of more than one RNAV system are not authorized, unless approved for that operator and each specific procedure, and

(3) In the event of failure of the airborne RNAV system, or other essential element of the airborne RNAV navigation or display system, or associated NAVAID(s), the instrument operation relying on RNAV can be safely discontinued from any point, and

(4) Following discontinuation of the RNAV operations, a transition can be safely made to use some other NAVAID or NAVAIDs, to safely complete subsequent flight to destination, diversion, or an alternate airport.

NOTE: A period of dead-reckoning may be permissible between the time the RNAV system is used and reversion to another system, or following NAVAID failure, to the time

alternate navigation means are established for continuing the missed approach and flight to alternate. During this period of dead-reckoning the aircraft should not be unduly exposed to loss of obstacle clearance due to proximity to terrain or significant obstacles. Suitable navigation performance should be achievable to safely complete the missed approach, fly to the alternate, and complete a subsequent approach using a different navigation system or NAVAID(s), without loss of knowledge of position, loss of appropriate obstacle clearance, or loss of terrain clearance.

4.3.4. FMS Use for RNP RNAV. Criteria for RNP RNAV is published in Advisory Circulars 90-RNP RNAV and 20-RNP.

4.3.5. VNAV. RNAV procedures typically use vertical navigation capability (VNAV) based on a descent/approach path utilizing the vertical and longitudinal elements associated with the defined lateral flight plan. A vertical element, in conjunction with an associated latitude/longitude location, forms a 3-dimensional point in space. A "Geometric VNAV Path" connects a series of 3-dimensional points in space to form a path from "Top of Descent" to "End of Descent." A "Flight Path Angle (FPA) VNAV Path" is defined by a 3-dimensional fix (latitude/longitude/altitude) and a flight path angle. The path extends rearward from the fix at the specified vertical angle.

a. FPA VNAV Paths (if and when used) typically are used for final approach segment path definition. An FPA path may or may not intersect other 3-dimensional waypoints. If an FPA path does not intersect a preceding 3-dimensional waypoint, then the VNAV system must compute a level segment until intercepting the FPA path. When barometric-based VNAV is used to transition to another vertical reference (i.e., ILS, MLS, GLS, or SBAS), the transition must be clearly identified.

b. Geometric VNAV paths may be used for all applications including final approach paths on RNAV approaches with VNAV minima.

4.3.5.1. VNAV Paths. VNAV paths may be defined as follows:

a. With constraints for "at," "at or above," "at or below," or with corresponding speed constraints; or

b. As an approximate straight-line segment from one defined Waypoint (WP) altitude to another WP altitude (following earth curvature); or

c. As two approximate straight line segments from one defined WP altitude to another WP altitude (following earth curvature), but using a reduced gradient for the final part of the path preceding the "to" WP to accommodate a speed constraint at the "to" WP.

4.3.5.2. Final Approach Segment.

a. When used for a final approach segment, VNAV paths may be based on a defined Flight Path Angle (FPA) descent path rather than a segment between two sequential WP altitudes and the VNAV capability must:

(1) Meet provisions of AC 20-129 for VNAV or criteria acceptable to the FAA; and

(2) Be capable of providing vertical tracking performance within ± 125 ft vertically (95%), excluding temperature correction for deviation from ISA; and

NOTE: Operational applications may be implemented to take advantage of improved vertical tracking performance (e.g., within +45 ft. or +15 ft. vertically (two sigma).

(3) Provide a VNAV path vertical displacement scale display showing a displacement range of ± 550 ft. or less (with a scale of ± 400 ft. recommended).

b. It is also recommended that the VNAV systems have digital readout capability available to the pilot showing vertical displacement (e.g., FMS progress page or equivalent).

c. For "Go-Around," when using a VNAV path for a final approach segment and a corresponding DA(H) is authorized for use, momentary descent below the DA(H) is considered acceptable while the airplane transitions from the descent approach path to a missed approach. Operators are not authorized to descend below an MDA without meeting the requirements of section 91.175. Criteria and procedures authorizing a DA in lieu of an MDA for certain existing instrument approach procedures meeting specified obstacle assessment provisions are contained in HBAT 99-08/HBGA 99-12.

4.3.6. RNAV Use for International Procedures. For international procedures, ICAO PANS-OPS may be used. In addition, operators may use criteria of FAA Order 8260.3, United States Standard for Terminal Instrument Procedures (TERPS), and related U.S. criteria, internationally when approved by FAA, and when found acceptable by the country in which the Aerodrome is located. For international operations, it is important to apply appropriate reference datum (e.g., WGS-84), and provisions for extreme cold temperature correction (see Table 6.2.10-1).

4.3.7. Inhibiting RNAV System Use of Inoperative or Unsuitable VOR, DME, Co-located VOR and TACAN (VORTAC), TACAN, or NDB NAVAIDs. If VOR, DME, VORTAC, TACAN, or NDB updating is used in support of position determination (e.g., FMS), operators and flightcrews should be aware of when and how to disable the use of an unsuitable NAVAID or NAVAID element within the NAS, by the RNAV system. This is especially true when the unsuitable NAVAID is likely to cause a significant map shift. (e.g., movement of a ground NAVAID to a new geographic location without making a corresponding update to that NAVAIDs recorded position in an airplane's navigation system database, thus leading to introduction of a sudden navigation system map display position error).

4.3.8. Use of RNAV (non-GPS) for Fix Substitution.

a. Non-GPS RNAV may be used to identify named fixes or unnamed fixes if:

- the named fix is part of the instrument procedure being flow
- the named fix is retrieved from the RNAV database
- the unnamed fix can be properly defined relative to a waypoint retrieved from the RNAV database
- the RNAV must determine fix position with the required degree of accuracy
- the RNAV must be certified for IFR flight operations, and
- the underlying NAVAID(s) identifying the fix is operational and monitored by the flightcrew

b. Use of non-GPS RNAV may be accepted on a case-by-case basis when the underlying NAVAID(s) is out of service in accordance with HBAT 99-08/HBGA 99-12.

4.3.8.1. NOTAMED VOR, LOCALIZER, TACAN, or DME NAVAID. If VOR, LOCALIZER, TACAN, or DME updating is used in RNAV position determination, operators and flightcrews must be aware of when and how to disable use of an unsuitable NAVAID(s).

4.3.9. Use of RNAV (GPS) for Fix Substitution. GPS may be used to identify named fixes or unnamed fixes if:

- the named fix is part of the instrument procedure being flown
- the named fix is retrieved from a current navigation database
- the unnamed fix can be properly defined relative to a waypoint retrieved from the RNAV database, and
- the GPS must be certified for IFR flight operations

4.3.10. Use of RNP RNAV for Fix Substitution. Criteria for the use of RNP RNAV is defined in AC 90-RNP RNAV.

4.4. Required Navigation Performance Area Navigation (RNP RNAV). A definition for RNP RNAV is specified in

Appendix 3 (See AC 20-RNP and AC 90-RNP) Assessment of RNP RNAV includes an evaluation of total system error (TSE) components: Path Definition Error (PDE), Position Estimation Error (PEE), and Flight Technical Error (FTE). In addition to TSE components, associated assurance limits are considered to determine what levels of navigation performance may actually be achieved with integrity. Approval may stipulate limitations or restrictions, such as certain RNP RNAV levels may only be achieved with flight director or autopilot coupled operation.

4.4.1. Standard RNP RNAV Levels.

a. Standard values of RNP RNAV are used to identify the navigation requirements for public procedures supporting initial, intermediate, or final approach segments, or missed approach segments as specified below:

Table 4.4.1-1.

STANDARD RNP RNAV LEVELS FOR APPROACH

Level	**Applicability/Operation** **(Approach segment)**
RNP-1.0 RNAV	Initial/Intermediate approach
RNP-0.3 RNAV	Initial/Intermediate/Final approach [supports limited CAT I minima]

b. ICAO specified types or levels of RNP as promulgated in ICAO Manuals or ICAO Regional Supplements for International Airspace may also be considered as standard RNP levels.

4.5. Flight Path Definition. Certain flight segments and waypoints are necessary to effectively implement approach and missed approach operations using landing systems where the required flight path is not inherent in the signal structure of the navigation aid (e.g., integrated multi-sensor area navigation systems and other RNAV systems such as satellite systems). These segments and concepts are described in RTCA/DO-201A and RTCA/DO-236.

a. In general, an operator must have an acceptable method to ensure that any waypoints or path points which are considered critical to an instrument procedure (if any) are correctly defined, and are loaded into each applicable airplane's database, initially, and at each change cycle.

b. Landing and Rollout Flight Path. The following criteria specifies certain reference points and other criteria necessary to effectively implement landing and rollout operations using a landing system where the required flight path (e.g., FAS and RWS) is not inherent in the signal structure of the navigation aid (e.g., for satellite based sensor systems). A graphic depiction of the points, heights, angles or other considerations described below is shown in Figure 4.5-1. The approach segment connects with the rollout segments. An approach flight path is considered to terminate at the beginning of the rollout segment.

c. Landing Threshold Point (LTP). The LTP is used in conjunction with the Flight Path Alignment Point (FPAP) and the vector normal to the WGS-84 ellipsoid at the LTP to define the geodesic plane of a final instrument approach flight path to touchdown and rollout (e.g., FAS). It is a point at the designated center of the landing threshold and is defined by a specified latitude, longitude, and ellipsoidal height. The LTP is a reference point used to connect the approach flight path with the runway.

d. Flight Path Alignment Point (FPAP). The FPAP is a point located on a geodesic line or an extension of a geodesic line calculated between the LTP and the designated center of the opposite runway threshold. It is positioned at a distance from the LTP to support a prescribed procedure design angular splay and course width, as well as functionality associated with an airplane. It is used in conjunction with the LTP to determine the lateral alignment of the vertical plane containing the path of the RNAV final approach segment. On shorter runways, the FPAP may be located off the departure end of the landing runway.

e. Flight Path Control Point (FPCP). The FPCP is a spatial point above the LTP used to define the vertical component (glide path angle) of the precision final approach path to the landing runway threshold. Vertically, the elevation of the FPCP is the elevation of the LTP plus the threshold crossing height (TCH).

f. Threshold Crossing Height (TCH). The height of the Flight Path Control Point (FPCP) above the Landing Threshold Point (LTP).

NOTE: A standard TCH is typically 50 ft. For sloped runway touchdown zones, a TCH in the range of 50 to 55 ft. above the designated datum point is acceptable. The maximum TCH for precision approaches is 60 ft. Other values are accepted on a case by case basis considering the airport need for a different value and the type of airplane and operations to be used (e.g., STOL). (Also see paragraphs 5.12.1 and 5.12.2).

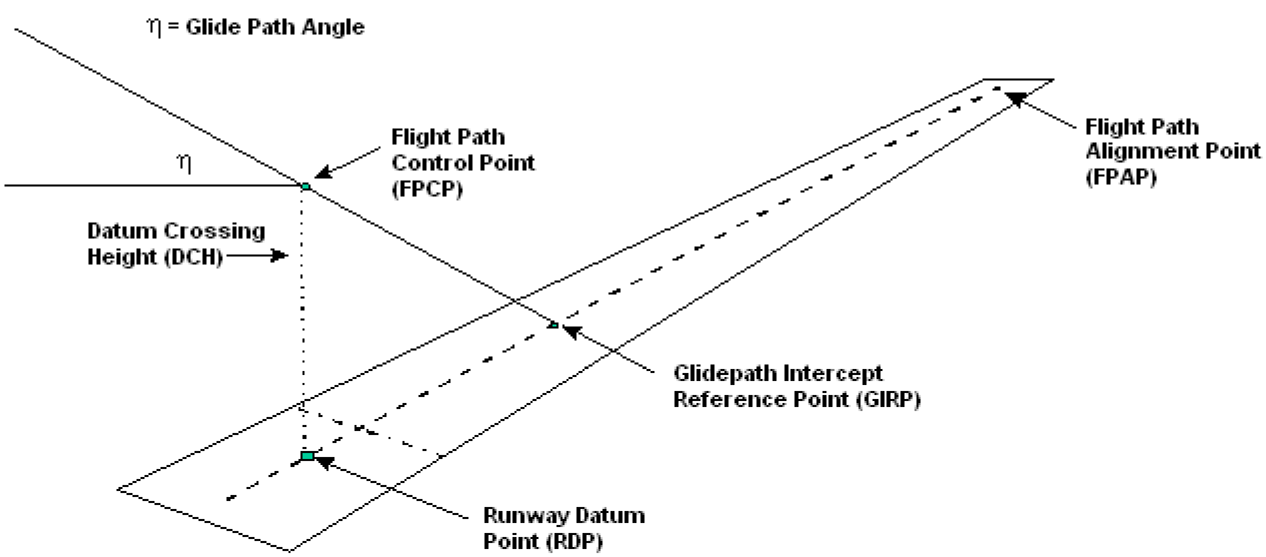
g. Glide Path Angle (GPA). The glide path angle is an angle defined at the FPCP that establishes the descent gradient for the final approach flight path (e.g., FAS) of an instrument approach procedure. It is measured in the geodesic plane of the approach (defined by the LTP, FPAP, and WGS-84 ellipsoid's geometric center). The vertical and horizontal references for the GPA are a vector normal to the WGS-84 ellipsoid at the LTP and a plane perpendicular to that vector at the FPCP, respectively.

h. Ground Point of Intercept (GPI). A point in the vertical plane on the runway centerline at which it is assumed that the straight line extension of the glide path intercepts a horizontal line tangent to the surface of the earth at the landing threshold point and aligned with the final approach course.

Points, Heights, Angles Or Other Considerations

For Definition of An Approach And Landing Flight Path

Figure 4.5-1.



i. The locations established for, and the values assigned to, the LTP, FPCP, TCH and GPA will be selected based upon the TERPS TCH requirements. Operational considerations include:

(1) Path of wheels over threshold(s);

(2) Need for coincidence with other aids and systems - visual and non-visual;

(3) Runway characteristics (upslope and downslope, crown etc.);

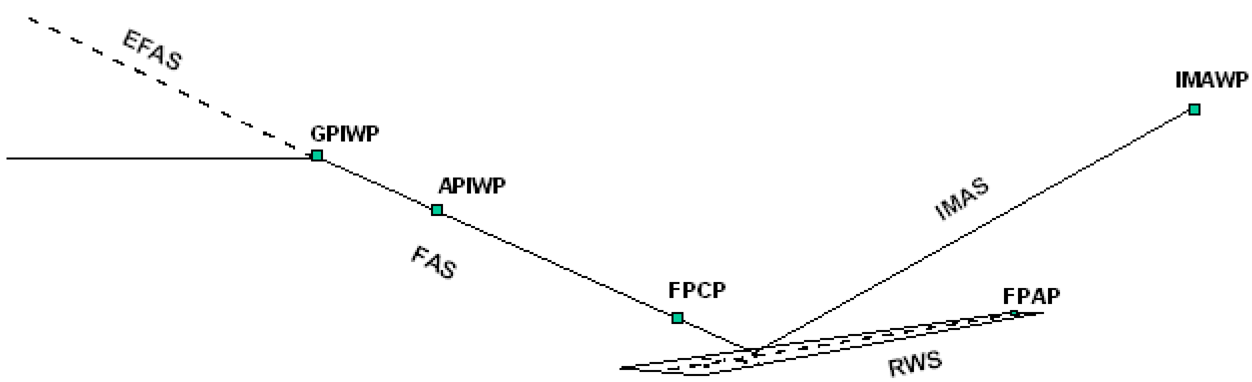
(4) Actual threshold, displaced threshold, or multiple threshold characteristics; and

(5) Actual clearway or stopway characteristics.

j. Approach and Missed Approach Segments. Figure 4.6-2 below shows the applicable reference points, path points, waypoints and leg types typically used to construct instrument approach procedures applicable to air carrier operations.

Figure 4.5-2.

Waypoint and Segment Placement



GPI

k. Procedure Design Related Waypoint Definitions and Use. The following procedure design-related waypoint definitions and uses are provided:

(1) Precision Final Approach Fix (PFAF). The point at which the established glide slope intercept altitude (MSL) meets the Final Approach Segment (FAS), on a standard day, using a standard altimeter setting (1013.2 HPa or 29.92 in).

(2) Approach Intercept Waypoint (APIWP). Approach Intercept Waypoint - A variable waypoint used when necessary to link a barometric LNAV/VNAV flight path with a FAS that is fixed in space (e.g., an xLS final segment). The APIWP permits LNAV and barometric VNAV segments, which may vary vertically in location on an approach as a function of barometric pressure setting or temperature variation from standard, to join or be connected to a FAS which is otherwise fixed in vertical location with respect to a runway.

(3) Missed Approach Turn Waypoint (MATWP). Missed Approach Turn Waypoint (Used only for Missed Approach Point (MAP)) - A waypoint generally aligned with the runway centerline, beyond the touchdown zone, used to establish a suitable initial climb segment beyond the touchdown zone. The MATWP intends to provide a safe path and altitude, if applicable, in the vicinity of the runway, to be used to establish a safe initial go-around path following a low altitude go-around or rejected landing.

l. Procedure Design Related Segment Definitions. The following procedure design-related segment definitions are provided:

Final Approach Segment (FAS)	The segment of an approach extending from the PFAF or Approach Intercept Waypoint (APIWP), whichever occurs later, to the Ground Point of Intercept (GPI). For the purpose of procedure construction and obstacle evaluation, the final approach segment is defined as beginning at the FAF and ending at the Landing Threshold Point (LTP).
Extended Final Approach Segment (EFAS)	That segment of an approach which is co-linear with the Final Approach Segment but which extends beyond the PFAF or Approach Intercept Waypoint (APIWP).
Runway Segment (RWS)	That segment of an approach from the Ground Point of Intercept (GPI) to Flight Path Alignment Point (FPAP).
Initial Missed Approach Segment (IMAS)	That segment of an approach from the Ground Point of Intercept (GPI) to the Missed Approach Turn Waypoint (MATWP).
Missed Approach Segment (MAS)	That segment of an instrument approach procedure from a point on the FAS corresponding to the position where the lowest DA(H) occurs under nominal conditions, to the designated missed approach holding WP, as specified for the procedure.

5. AIRBORNE SYSTEM PERFORMANCE.

5.1. General. Airborne performance is addressed as part of the airworthiness approval of the airplane. This paragraph identifies unique issues that may be demonstrated post-certification in order to obtain operational approval. Airplane related systems are addressed in paragraph 5.1.1; non-airplane systems (e.g., NAVAIDs) are addressed in paragraph 5.1.2; specification of flight path is addressed in paragraph 5.1.3; and specific airborne equipment requirements for Nonprecision, Category I, or II authorizations are addressed in paragraphs 5.2 and 5.3.

5.1.1. Airborne Systems.

a. Airworthiness criteria for airplane systems intended to meet requirements of this AC are specified in Appendix 1 and 2 for Nonprecision, Category I, and II and when applicable in 20 series AC's (e.g., AC 20-138, AC 20-130A, AC 20-129). Performance and operational requirements for the airborne system are contained in paragraphs 5.1.3 through 5.20 below.

b. For airplanes which completed an airworthiness demonstration applicable to Nonprecision, Category I, or II using earlier versions of this AC, or previous applicable AC's, may be continued only as provided for in standard OpSpecs.

5.1.2. Non-Airborne Systems (e.g., NAVAIDs or equivalent GNSS capability). Non-Airborne systems must be maintained to the performance level commensurate with the operation authorized by Flight Standards and as evaluated by FAA Aviation System Standards (AVN), Flight Inspection Operations Division, before final approval for flight operations.

a. The classification should be specified in a manner suitable to address:

(1) Intended NAVAID performance level (or an equivalent capability for GNSS);

(2) Signal or capability coverage respect to the intended flight path(s) and runway; and

(3) NAVAID or capability "availability and integrity" (e.g., considering standby capability and power, as applicable).

b. This classification scheme should at least be provided for any xLS capability (e.g., ILS, MLS, or GLS). This is done by use of FAA or ICAO criteria. (FAA Order 6750.24 as amended, or ICAO Annex 10) NAVAID facility or capability operational use is then predicated on suitable facility or capability classification respectively for ILS, MLS, or GLS (e.g., for ILS, III/E/2).

c. At non-ICAO foreign facilities, consideration of equivalence to the ICAO or FAA classification may be necessary for operational authorizations. Classification for ICAO State's facilities can be found in that State's Aeronautical Information

Publication (AIP) or it should be available on request.

5.1.3. Flight Path Specification.

5.1.3.1. Lateral.

a. Nonprecision and Category I. The following demonstrations are acceptable for obtaining operational approval at the corresponding minima.

Table 5.1.3.1-1.

NONPRECISION and CATEGORY I - LATERAL PERFORMANCE/MINIMA

	Minima	Operational Demonstration
1)	Minima equivalent to ILS at 200 ft. HAT (ILS/MLS/GLS)	Lateral tracking performance from 1000 ft. HAT to 200 ft. HAT should be stable without large deviations (i.e., within ±50 microamps deviation) from the indicated course or path, or equivalent; using at least 3 different representative facilities for a minimum of 9 total approaches. System performance should be acceptable without undue oscillation.
2)	Minima not lower than a DA(H) of 250 ft. HAT (RNAV approach with VNAV minima)	Lateral tracking performance from 1000 ft. HAT to 250 ft. HAT should be stable without large deviations (i.e., within ±50 microamps deviation) from the indicated course or path, or equivalent; using at least 3 different representative facilities for a minimum of 9 total approaches. System performance should be acceptable without undue oscillation.
3)	Minima not lower than an MDA of 250 ft. HAT or specified by Standard OpSpecs/SIAP (LNAV, LOC, LOC BC, VOR, VOR/DME, NDB, ASR, PAR, RNP RNAV 0.5 or 0.3)	Lateral tracking performance from 1000 ft. HAT to 250 ft. HAT should be stable without large deviations from the indicated course or path, or equivalent; using at least 3 different representative facilities for a minimum of 9 total approaches. System performance should be acceptable without undue oscillation.

b. Category II. The following demonstrations are acceptable for obtaining Category II operational approval at the corresponding minima.

Table 5.1.3.1-2.

CATEGORY II - LATERAL PERFORMANCE/MINIMA

	Minima	Demonstration
1)	Minima equivalent to ILS at 100 ft. HAT (i.e. ILS/MLS/GLS)	Lateral tracking performance from 1000 ft. HAT to 300 ft. HAT should be stable without large deviations from the indicated course or path, and from 300 ft. HAT to 100 ft. HAT within ±25microamps deviation from the indicated course or path, or equivalent, (for 95% of the time/per approach) using at least 3 representative facilities and for a minimum of 20 total approaches. System performance should be acceptable

		without undue oscillation.* * NOTE: Or using JAA ACJ AWO 231 Method

c. Lateral Performance below or beyond DA(H). For either Category I or II procedures with a DA(H) below 250 ft. HAT*, when guidance is provided (e.g., for autoland, or HUD flare/rollout), the lateral performance should at least be equivalent to that attainable using an ILS Type I/E/1 localizer from 200 ft. HAT, or 100 ft. HAT as applicable, to the end of rollout.

***NOTE: This provision does not apply to systems intended for Category III. (see AC120-28D for Category III requirements)**

d. From 200 ft. HAT or 100 ft. HAT, as applicable, until returning to an established missed approach segment of the approach procedure, if guidance is provided, performance should be at least equivalent to that attainable using an ILS Type I/E/1 localizer front and back course.

5.1.3.2. Vertical.

a. Nonprecision and Category I. The following demonstrations are acceptable for obtaining operational approval at the corresponding minima.

Table 5.1.3.2-1.

NONPRECISION and CATEGORY I - VERTICAL PERFORMANCE/MINIMA

	Minima	Operational Demonstration
1)	Minima equivalent to ILS at 200 ft. HAT (ILS/MLS/GLS)	Vertical tracking performance from 700 ft. HAT to 200 ft. HAT should be stable without large deviations (i.e., within ±75 microamps deviation) from the indicated path, or equivalent, using at least 3 different representative facilities and for a minimum of 9 total approaches. System performance should be acceptable without undue oscillation.
2)	Minima not lower than a DA(H) of 250 ft. HAT (RNAV approach with VNAV minima)	Vertical tracking performance from 700 ft. HAT to 250 ft. HAT should be stable without large deviations (i.e., within ±75 microamps deviation) from the indicated path, or equivalent, using at least 3 different representative facilities and for a minimum of 9 total approaches. System performance should be acceptable without undue oscillation.
3)	Minima not lower than an MDA of 250 ft. HAT or specified by Standard OpSpecs/SIAP (LNAV, LOC, LOC BC, VOR, VOR/DME, NDB, ASR, PAR, RNP RNAV)**	Vertical tracking performance from 700 ft. HAT to 250 ft. HAT should be stable without large deviations from the indicated path, or equivalent, using at least 3 different representative facilities and for a minimum of 9 total approaches. System performance should be acceptable without undue oscillation.

****NOTE: Flight guidance providing a stabilized approach from the Final Approach Fix to MDA is recommended for these procedures (except this note does not apply to PAR).**

b. Category II. The following demonstrations are acceptable for obtaining Category II operational approval at the corresponding minima.

Table 5.1.3.2-2.

CATEGORY II - VERTICAL PERFORMANCE/MINIMA

1)	Minima equivalent to ILS at 100 ft. HAT (ILS/MLS/GLS)	Vertical tracking performance from 700 ft. HAT to 300 ft. HAT should be stable without large deviations (within ±75 microamps deviation) from the indicated path, and from 300 ft. HAT to 100 ft. HAT within ±35 microamps deviation from the indicated course or path, or ±12 ft, which ever is greater, or equivalent, (for 95% of the time/per approach) using at least 3 different representative facilities and for a minimum of 20 total approaches. System performance should be acceptable without undue oscillation**.**

c. Nonprecision, Category I, or Category II.

(1) **Vertical (VNAV) performance at altitude constraints prior to a Final Approach Fix (FAF) or Final Approach Point (FAP), or at a FAF or FAP.** For use of VNAV on segment(s) prior to a FAF or FAP, at a FAF or FAP

(e.g., intercepting a FAS from an en route segment, Standard Terminal Arrival Route (STAR), Profile Descent, initial approach or intermediate approach segment), vertical performance should normally be based on use of a vertical "Fly by" path rather than a "Fly over" path. Performance requirements relating to this fly-by capability are defined in RTCA/DO-236A The operational use of vertical flyby waypoints must be compatible with TERPS obstacle clearance criteria and the flightcrew evaluation standards. The small vertical displacement which may occur (40 ft. - 80 ft.) at a vertical constraint as a result of using a vertical "Fly by" waypoint rather than vertical "Fly over" waypoint is considered operationally acceptable, and desirable, to ensure asymptotic capture of a new (next) vertical segment. This applies to both "level off" or "altitude acquire" segments following a climb or descent, or vertical climb or descent segment initiation, or joining of climb or descent paths with different gradients.

NOTE: A "Fly By" vertical waypoint is a WP for which an airplane may initiate a vertical rate change and depart the specified vertical path to the active WP prior to reaching that WP, in order to asymptotically capture the next vertical path. A "Fly Over" vertical waypoint is a WP for which an airplane must stay on the defined vertical path until passing the active WP, and may not initiate the necessary vertical rate change to capture the next vertical path until after passing the active WP. Hence, after passing the active WP, as the next WP becomes active, and if there is a vertical path change, then the airplane must re-adjust vertical rate to re-capture the vertical path after having already overshot the first opportunity for an asymptotic capture of that new path.

(2) **Vertical (VNAV) performance at waypoint altitude constraints near the point at which DA(H) or MDA may occur.** For procedures with waypoints at or near the point at which DA(H) or MDA occur, vertical (VNAV) performance should not preclude continuous descent of the airplane to the runway, following the established VNAV path to the runway (e.g., VNAV should not initiate capture of a missed approach segment and automatic level off (at MDA or initiate the MAP climb, without pilot confirmation that a missed approach or go-around is intended (e.g., Take-off or Go-Around (TOGA) initiation)).

(3) **Vertical (VNAV) performance below or beyond DA(H) or MDA.** For procedures with a DA(H) below 200 ft. HAT (e.g., for autoland, or HUD flare/rollout), the glide path/glide slope vertical performance should at least be equivalent to that attainable using an ILS glide slope at a facility classified as Type I/E/1, between 200 ft. HAT and 50 ft. HAT.

***NOTE: This provision does not apply to systems intended for Category III (see AC120-28D for Category III requirements).**

5.1.3.3. Longitudinal.

a. Methods supporting longitudinal (along track) positional awareness for Nonprecision, Category I, or II operations are as specified below. Any one or more of the longitudinal methods appropriate to the airborne system may be demonstrated, and should be identified as the basis for the demonstration.

- VHF Outer Marker (OM)/Middle Marker (MM) Marker Beacons
- VOR/TACAN Fixes (other than for MM)
- Compass Locator Outer Marker (LOM)/Compass Locator Middle Marker (LMM) NDB's
- DME Distance Information
- RNAV Fixes (other than for MM)
- Distance to "Runway Threshold WP"

b. If longitudinal information is not provided, or if it is provided via alternate means (e.g., fan marker or radar fix), restricted minima and/or demonstration may apply.

5.1.3.4. Typical Wind and Wind Gradient Disturbance Environment. The lateral and vertical performance described above should typically be expected to be achievable in conditions at least as described below. Performance may be assessed analytically, demonstrated in simulation, or demonstrated in flight. Relevant associated information on demonstrated winds encountered or estimated wind gradient capability may be included in the AFM, as desired by the applicant.

a. Systems intended for use with procedures for either Nonprecision, Category I, or Category II should be capable of coping with at least the following wind, wind gradient, and turbulence conditions:

- Reported Surface Headwind Component - 25 kts
- Reported Surface Tailwind Component - 10 kts
- Reported Surface Crosswind Component - 15 kts

b. Wind Gradients/Shear - at least 4 kts per 100 ft. from 500 ft. HAT to the surface;

c. Recommended Capability - Ability to cope with 8 kts per 100 ft. for 500 ft., moderate turbulence, knife edge shears of at least 15 kts over 100 ft., 20 kts lateral directional vector shears of 90 degrees over 100 ft., and ability to cope with a 20 kts logarithmic shears between 200 ft. and the surface.

5.2. Airborne Equipment for Nonprecision and Category I. The following equipment (along with any additional equipment specified by 14 CFR for IFR flight) is the minimum airplane equipment considered necessary for an authorization for Nonprecision and Category I.

a. For ILS, GLS, or MLS approach capability:

- Two navigation receivers, or equivalent type of device, of each type intended for use

NOTE 1: The navigation receivers specified above may be provided as two or more integrated multi-sensor units (e.g., MMR).

NOTE 2: Installation of only one navigation receiver or one data link receiver capable of receiving GBAS uplinked corrections for GNSS position fix correction data may be authorized by FAA for special circumstances, considering the particular facilities and routes to be used, such as if suitable minima restrictions and requirements for alternate

navigation capability are applied (e.g., 1 GLS receiver if two ILS receivers are installed).

• Suitable navigation displays, attitude, vertical speed, and airspeed displays for each pilot (see Paragraph 5.9 for details)

• Suitable failure annunciation visible to each pilot

• One or more Marker Beacon systems (unless an approved RNAV substitute is available, or if not necessary for the route of flight, including alternates)

• One or more DME's (unless an approved RNAV substitute is available, or if not necessary for the route of flight, including alternates)

• One or more Automatic Direction Finders (ADF) - (14 CFR 121 operators may use an approved RNAV substitute system, if available, unless ADF is not required for the intended route of flight, including alternates)

NOTE: 14 CFR 121 Operators—Two (2) ADF's may be required IAW section 121.349 for certain international operations, and for certain obstacle or terrain critical departure, approach, or missed approach procedures (e.g., when required by procedure or for alternate airport requirement).

• For airplanes intended for approval of landing minima below RVR3000, at least one flight director or one autopilot

• It is recommended that the following capability be available:

- Radar Altimeter

- Standby power for at least one pilot's ILS/GLS navigation receiver and displays

- Rain removal capability

b. For approaches other than ILS, GLS, or MLS (e.g., RNAV with VNAV minima, RNAV, VOR, VOR/DME, NDB).

• Two navigation receivers and associated displays of the type of the approach system to be used (unless otherwise authorized by FAA for the facilities and route to be used), or

• Two RNAV/FMS systems (unless use of 1 is authorized by FAA for the facilities and route to be used) which are capable of using the necessary NAVAIDs or equivalent (e.g., space vehicles (SVs)), or which can be monitored by using situation information NAVAID data (e.g., on an associated ND or RDMI)

• Suitable navigation displays, attitude, vertical speed, and airspeed displays for each pilot (see paragraph 5.9 for details)

• Suitable failure annunciation visible to each pilot

• For ASR or PAR, at least 2 communication radios capable of receiving communications of ASR or PAR information

• It is recommended that the following capability be available:

- Radar Altimeter.

- Standby power for at least one pilot's VOR or RNAV navigation receiver and displays.

- Rain removal capability.

c. For airplane types and systems approved previously to issuance of this AC or equivalent criteria, the airplane must have a system which meets that earlier criteria. Airplanes demonstrated using earlier criteria may continue to be approved for Nonprecision, Category I operations in accordance with (IAW) that earlier criteria, however operators seeking additional capability provided for in this AC must use the criteria contained in this AC.

d. For requirements related to equipment inoperative dispatch pertaining to Nonprecision, Category I approach capability see Paragraph 5.21. For situations involving in-flight failure of equipment pertaining to Nonprecision, Category I approach capability (see paragraph 5.22).

5.3. Airborne Equipment for Category II.

a. The following equipment (along with any applicable equipment otherwise specified above for Category I) is the minimum airplane equipment considered necessary for an authorization for Category II.

(1) Two independent navigation receivers, or equivalent, of each type intended for use,

> **NOTE 1: The navigation receivers specified above may be provided as two or more integrated multi-sensor units (e.g., MMR),**

(2) A suitable Automatic Flight Control System, or manual flight guidance system, or both (e.g., flight director) as follows:

• A system or systems designed to meet criteria of Appendix 2, or

> • For airplane types and systems approved previously to issuance of this AC or equivalent criteria, the airplane must have a system which meets that earlier criteria. Airplanes demonstrated using earlier criteria may continue to be approved for Category II operations IAW that earlier criteria, however operators seeking additional capability provided for in this AC must use the criteria of this AC.

> • At least 1 autopilot (AFGS) and at least dual flight director systems with an independent display for each pilot is recommended. Dual systems which provide the same information to both pilots, with the second system in "hot standby status" may be acceptable only if suitable comparison monitoring between the systems is available, and timely transfer to standby can be completed, and suitable annunciation to the flightcrew is provided.

(3) A radar altimeter display for each pilot. (Note: At least 2 independent radar altimeters with a display for each pilot are recommended.)

(4) Rain removal equipment is required for each pilot (e.g., windshield wiper, bleed air). (Note: hydrophobic coating is recommended for each applicable forward windshield, in lieu of rain repellent, due to environmental considerations.)

(5) Flight instruments and annunciations which can reliably depict relevant aspects of the airplane position relative to the approach path, attitude, altitude and speed, and aid in detecting and alerting the pilots in a timely manner to failures, abnormal lateral or vertical displacements during an approach, or excessive lateral deviation (see Paragraph 5.9 for details).

(6) An autothrottle system should be provided unless otherwise approved by the FAA and based on demonstration of acceptable pilot workload.

b. For requirements related to equipment inoperative dispatch pertaining to Category II approach capability, see Paragraph 5.21. For situations involving in-flight failure of equipment pertaining to Category II approach capability, see paragraph 5.22.

5.3.1. Standard Category II Minima. Standard Category II minima are a DA(H) of 100 ft. HAT and RVR not less than 1200 ft. (350m).

5.3.2. Special Category II Authorizations. Special Category II minima may be authorized for certain qualifying ILS/GLS facilities (e.g., Type I ILS). Minima at these facilities may be restricted depending on NAVAID, airport facility, and obstacle assessments by FAA Order 8260.3. Order 8400.13 addresses standard provisions applicable to these authorizations. Any authorizations issued should be consistent with one or more of the following DA(H) and RVR paired provisions.

- DA(H) 150 ft. HAT RVR 1600
- DA(H) 100 ft. HAT RVR 1600
- DA(H) 100 ft. HAT RVR 1200

5.4. Automatic Flight Control Systems and Automatic Landing Systems. Automatic Flight Control Systems, Autoland Systems, or Manual Flight Guidance systems (e.g., HUD) are recommended for Category I or II ILS, MLS, or GLS procedures which do not have restrictions on localizer or glide slope or equivalent signals (e.g., Glide Slope unusable below 500 ft. HAT, or Localizer unusable inside threshold).

5.5. Flight Director Systems. Characteristics of Flight Director Systems (head down or head up) used for airplane authorized for Nonprecision, Category I, or II should be compatible with the characteristics of the autopilot or autoland system used. Regardless of whether Flight Director commands are provided, situational information displays of navigation displacement must also be provided to both flight crewmembers. To ensure that unacceptable deviations and failures can be detected, the displays must be appropriately scaled and readily understandable in the modes or configurations applicable.

5.6. Head-up Display Systems. Head-up Display systems used as the basis for a suitable Nonprecision, Category I, or II authorizations must provide guidance for one or both pilots as appropriate for the system design. If information is provided to only the pilot flying (PF), then appropriate monitoring capability must be established for the pilot not flying (PNF). Monitoring tasks must be identified in the AFM, and the PNF must be able to assume control of the airplane in the event of system failure or incapacitation of the PF using the HUD (e.g., for a safe go-around or completion of rollout). Head-up Display Systems acceptable for Nonprecision, Category I, or II must meet provisions of Appendix 1 or 2 respectively, or acceptable earlier criteria specified by the FAA and referenced in an AFM.

5.7. Enhanced/Synthetic Vision Systems. Enhanced/Synthetic Vision Systems based on forward looking infrared radar or millimeter wave radar or other such sensors may be used to ensure the integrity of other flight guidance or control systems in use during Nonprecision, Category I, or II operations. They must be demonstrated to be acceptable to FAA in a proof of concept evaluation (see paragraph 10.18) and must meet the requirements of Appendix 1 or 2 of this AC. Use of Enhanced/Synthetic Vision Systems for purposes other than establishing the accuracy or integrity of flight guidance system performance must be demonstrated to be acceptable through proof of concept testing prior to identification of specific airworthiness and operation criteria.

5.8. Hybrid Systems. A hybrid system is one that uses both an autopilot and enhanced display (e.g., a fail passive autoland system used in combination with a monitored HUD flight guidance system). Hybrid systems may be acceptable for Nonprecision, Category I, or II if the system provides the equivalent performance and safety to a non-hybrid system as specified for the minima sought.

a. Hybrid systems with automatic landing capability should be based on the concept of use of the automatic landing system as the primary means of control, with the manual flight guidance system serving as a backup mode or reversionary mode.

b. Any transition between hybrid system elements (e.g., control transition from autoland use to manual control HUD use, or for response to failures) must be acceptable for use by properly qualified flightcrews (e.g., qualified IAW part 121, an approved Advanced Qualification Program (AQP), or equivalent JAA criteria, as applicable, and standard industry practices). Transitions should not require extraordinary skill, training, or proficiency.

c. For any system which requires a pilot to initiate manual control at or shortly after touchdown, the transition from automatic control prior to touchdown to manual control using the remaining element of the hybrid system (e.g., HUD) after touchdown must be demonstrated to be safe and reliable.

5.9. Instruments, Systems, and Displays. The following identifies Flight Instrument, Systems, and Display presentations requirements for Nonprecision, Category I, and Category II operations:

5.9.1. Instruments, Systems, and Displays for Nonprecision and Category I.

a. Each required pilot (Pilot Flying (PF) and Pilot Not Flying (PNF)) must have a display of, attitude, barometric altitude, airspeed, vertical speed and suitable standby attitude information (e.g., attitude indicators, Electronic Attitude Director Indicator (EADI), or primary flight displays).

b. Each required pilot (PF and PNF) must have a display of lateral deviation from the desired path (e.g., Horizontal Situation Indicator (HSI), Electronic Horizontal Situation Indicator (EHSI), Navigation Display (ND)). This display must be based upon the sensor approved for the approach (e.g., ILS localizer). The display must also annunciate failure of this capability.

c. Instrument and panel layouts must follow accepted principles of flight deck design (e.g., basic-T format, conventions for airspeed and altitude scales).

d. For ILS, MLS, and GLS approaches, and RNAV approaches with VNAV minima.

(1) Each required pilot (PF and PNF) must have a display of vertical deviation from the desired path (e.g., HSI's, EHSI's, ND). This display must be based upon the sensor approved for the approach (e.g., ILS localizer). The display must also annunciate failure of this capability.

(2) For any operation intended for use with a DA(H) below 250 ft. HAT, lateral and vertical displacement information must be provided on the PFD, EADI, Attitude Director Indicator (ADI), or equivalent.

e. Each required pilot (PF and PNF) should have a display of the Decision Altitude (Height) or Minimum Descent Altitude (Height). Each required pilot should have longitudinal information as described in 5.1.3.3.

> **NOTE: Unless otherwise approved by FAA, advisory indications should be expressed as either "RH" or "RA" for radar/radio height or altitude, and as "BARO" for barometric altitude. Flight deck depiction of radio and barometric height or altitude advisories should not typically use the operational designations of "DH" or "MDA."**

f. System status and failure annunciations suited to the guidance systems used, navigation sensors used, and any related airplane systems (e.g., autopilot, flight director, electrical system) should be provided.

g. Automatic audio call-outs as described in paragraph 5.11 are recommended.

h. A suitable rain removal method is recommended for each pilot for Nonprecision and Category I operations. Suitable methods typically include windshield wipers, bleed air windshield rain removal, or hydrophobic coatings.

5.9.2. Instruments, Systems, and Displays for Category II.

a. Each required pilot (PF and PNF) must have a display of attitude, barometric altitude, airspeed and vertical speed and suitable standby attitude information (e.g., attitude indicators, EADI's, or primary flight displays).

b. Each required pilot (PF and PNF) must have a display of lateral deviation from the desired path (e.g., HSI's, EHSI's, ND). This display must be based upon the sensor approved for the approach (e.g., ILS localizer). The display must also annunciate failure of this capability.

c. Instrument and panel layouts must follow accepted principles of flight deck design (e.g., basic-T format, conventions for airspeed and altitude scales).

d. Suitable redundant lateral and vertical path displacement information from the final approach course and specified glide path must be provided.

(1) Lateral and vertical displacement information must be provided on the PFD, EADI, ADI, or equivalent to each pilot independently.

(2) Lateral displacement expanded scale information must be provided to confirm that the airplane position with respect to intended flight path and the landing runway on each PFD, EADI, ADI, or equivalent (e.g., for ILS, a full scale sensitivity of 1 Dot (0.0775 ddm)).

e. An autopilot or flight director system suitable for the minima to be authorized.

f. Unless otherwise approved by the FAA for Category II operations based on autopilot use alone, flight director(s), or command guidance information, should be provided for each pilot, suitable for the minima to be authorized. At least dual independent system capability must be installed for Category II operations for airplanes which are certificated with more than one required pilot.

NOTE: For Head Up Display (HUD) operations, availability of the information in d. above, does not necessarily substitute for availability of this information on pertinent head-down displays (HDD's). Configurations found acceptable to FAA include use of a compatible HUD and HDD's at the Crewmember 1 (CM1/Captain) flight deck station, and suitable and comparable HDD's at the Crewmember 2 (CM2 /First Officer (FO)) flight deck station, each with adequate flight path display and failure annunciation. Use of other HUD/HDD configurations for CM1 and CM2 must be evaluated by FAA and be determined to provide acceptable and equivalent or better capability.

g. Each required pilot (PF and PNF) should have a display of the Decision Altitude (Height). Each required pilot should have longitudinal information as described in 5.1.3.3.

NOTE: Unless otherwise approved by FAA, advisory indications should be expressed as either "RH" or "RA" for radar/radio height or altitude, and as "BARO" for barometric altitude. Flight deck depiction of radio and barometric height or altitude advisories should not typically use the operational designations of "DH" or "MDA."

h. System status and failure annunciations suited to the guidance systems used, navigation sensors used, and any related airplane systems (e.g., autopilot, flight director, electrical system) should be provided.

i. Automatic audio call-outs as described in paragraph 5.11 are recommended.

j. A suitable rain removal method is required for each pilot for Category II operations. Suitable methods typically include windshield wipers, bleed air windshield rain removal, or hydrophobic coatings.

k. A demonstration of the suitability of any indications for non-normal configurations for which operational approval is sought (e.g., electrical configurations, hydraulic power).

5.10. Annunciations. Annunciations must be clear, unambiguous, and appropriately related to the flight control mode in use. The mode annunciation labels should not be identified by landing minima classification. Examples such as APPROACH, LAND 2, LAND 3, Single Land, and Dual Land are acceptable mode annunciation labels, whereas, "Category II," "Category III," etc., should not be used. Airplanes previously demonstrated for Nonprecision, Category I or II which do not meet this criteria may require additional operational constraints to assure the correct use of minima suited to the airplane configuration.

5.11. Automatic Aural Alerts.

a. Automatic Aural Alerts (automatic call-outs, voice call-outs, etc.) of radar altitude, or call-outs approaching landing minimums, or call-outs denoting landing minimums are recommended and should be consistent with the design philosophy of the airplane in question. However, any automatic call-outs used should not be of a volume or frequency that interferes with necessary flightcrew communications or normal flightcrew coordination procedures. Recommended automatic call-outs include a suitable alert or tone as follows:

(1) At 500 ft. (radar altitude),

(2) Approaching minimums,

(3) At minimums, and

(4) Altitude call-outs during flare, such as at "50" ft., "30" ft. and "10" ft., or altitudes appropriate to airplane flare characteristics.

b. Low altitude radio altitude call-outs, if used, should be spaced properly to address the situation of higher than normal sink rate during flare, or an extended flare which may be progressing beyond the touchdown zone. Other alerts may be used when approved by the FAA, if those alerts are consistent with that operators approved procedures and minima, and do not impair crew communication.

5.12. Navigation Sensors.

5.12.1. Airplane Navigation Reference Points, Wheel to Eye Height, and Wheel to Navigation Reference Point Height. To ensure suitable wheel height and clearance over the threshold of runways when following a vertical path and when using visual references (e.g., Visual Glide Slope Indicator (VGSI)/PAPI) airplane manuals should specify the height of the pilots eye reference point above the wheel path, and the height below the flight path (e.g., glideslope) of the wheel path during landing. These heights are specific to each airplane type. This information should be available to the operator and pilot for use in determining any constraints or recommendations for proper VGSI/PAPI use and minimum threshold crossing height (TCH).

NOTE: The FAA operational objective for locating the ILS glide slope is to provide a commissioned TCH which will result in a wheel crossing height (WCH) of 20 ft. for the types of airplanes with the greatest glidepath-to-wheel height normally expected to use the runway.

5.12.2. Assessment of Threshold Crossing Height (TCH), Approach Descent Gradient, and Runway Slope. Typically, procedures are designated with vertical path runway threshold crossing height in the range of 50 to 60 ft. Operators should assess instrument procedures to be used at regular, alternate, and provisional airports, and at planned diversion contingency airports to ensure satisfactory Threshold Crossing Height (TCH) for the type of airplanes to be flown. TCH's which result in a wheel crossing height (WCH) of less than 20 ft. should not be used by wide body air carrier airplanes without special review by the operator.

a. For operations on facilities where a TCH (glideslope or VNAV) results in a wheel crossing height of less than 20 ft., the operator and CHDO should consider the advisability of those operations on a case by case basis. Considerations should include any obstructions in the pre-threshold area, the amount the glideslope or VNAV path is below standard values, airplane type and airplane characteristics as proposed for the operation, whether the runway under-run area is a full load-bearing surface, placement of lighting aids (threshold lights/approach lights), availability, and suitability of VGSI, weather minima to be used, and any other relevant factors.

b. Operators should assess instrument procedures to be used at regular, alternate, and provisional airports, and at planned diversion contingency airports to ensure that final approach descent gradients specified are appropriate for the type of airplane to be flown, and for conditions expected to be encountered (e.g., engine-out flap settings and speeds, anti-ice operating). For facility, obstacle, or terrain constraints, certain airports served by air carrier airplanes have unusually steep gradients (Stephenville, Newfoundland - CYJT) or unusually shallow gradients (Kodiak, Alaska - PADQ) that may have operational consequence for certain airplane types.

c. Under extreme cold temperature conditions certain VNAV paths may be more shallow than normal, and under extreme high temperatures these VNAV paths may be steeper than normal (see paragraph 6.2.10). In either case, the paths may not closely align with fixed visual aids such as VGSI/PAPI.

d. Certain runways that have an unusual general slope or complex varying slope should be assessed by the operator for pilot awareness and for operational consequence (e.g., operator specifies that the airplane must touchdown by a certain point on the runway, or the last portion of the runway is not visible during flare in the TDZ due to changing slope).

5.13. Supporting Systems and Capabilities.

5.13.1. Flight Deck Visibility. Forward and side flight deck visibility for each pilot should be provided as follows:

a. The airplane should have a suitable visual reference cockpit cutoff angle over the nose for the intended operations, at the intended approach speeds, and for the intended airplane configurations, as applicable (e.g., flap settings);

b. The airplane's flight deck forward and side windows should provide suitable visibility for taxi and ground operations in low visibility; and

c. Placement of any devices or structure in the pilot's visual field which could significantly affect the pilot's view for low visibility operations must be acceptable (e.g., HUD drive electronics, sun visor function or mountings).

5.13.2. Rain and Ice Removal.

a. Suitable windshield rain removal, ice protection, or defog capability should be provided as specified below:

(1) Installation of rain removal capability is recommended for Nonprecision, Category I, and required for Category II (e.g., windshield wipers, windshield bleed air).

(2) Installation of use of windshield hydrophobic coatings, or use of equivalent rain repellent systems which meet pertinent environmental standards are recommended.

(3) Installation of windshield anti-ice or de-ice capability is recommended for Nonprecision, Category I, and required for Category II for airplanes intended to operate in known icing conditions during approach and landing.

(4) Installation of at least forward windshield defog capability is recommended for airplanes subject to obscuration of the pilot's view during humid conditions.

b. Airplanes subject to obscuration of the windshield due to rain, ice, or fogging of the pilot's view which do not have protection, or which do not have adequate protection may require operational limitations on the conditions in which low visibility operations are conducted.

5.13.3. Miscellaneous Systems. Supporting systems include instruments, radar altimeters, air data computers, inertial reference units, instrument switching, or capabilities such as flight deck night lighting, landing lights and taxi lights, position, turnoff and recognition lights, flight data recorders, and cockpit voice recorders. These systems must meet applicable criteria in Appendix 1 or 2, in basic airworthiness requirements, or acceptable earlier criteria authorized by FAA for airplanes previously demonstrated to be acceptable for Nonprecision, Category I, or Category II operations. See paragraphs 5.19 and 5.20 for Ground Proximity Warning System (GPWS), Terrain Awareness and Warning System (TAWS), and Flight Data Recorder (FDR) provisions.

5.14. Go-Around Capability. For airplanes authorized for instrument approaches, and particularly for airplanes intended for operation to Category II minima, evaluation of go-around capability should include both normal and non-normal operations. Assessment should account for factors related to airplane geometric limitations (e.g., fuselage attitude and potential for tail strike) during the transition to go around, limited visual cues, autoflight system mode switching if applicable, and any other pertinent factors identified by FAA. For airplanes in which a go-around from a very low altitude may result in an inadvertent touchdown, the safety of such a procedure should be established considering its effect on related systems (e.g., operation of autospoilers, automatic braking systems, autopilot/flight director mode switching, autothrottle operation and mode switching, and reverse thrust initiation).

a. If an automatic or flight director go-around capability is provided, it should be demonstrated that a go-around can be safely initiated and completed from any altitude to touchdown. If an automatic go-around mode can be engaged at or after touchdown, it should be shown to be safe. The ability to initiate an automatic or flight director go-around at or after touchdown is not required or appropriate. Inadvertent selection of go-around after touchdown (either an automatic or flight director go-around capability) should have no adverse effect on the ability of the airplane to safely rollout and stop.

b. Regardless of the flight guidance system used, availability of appropriate information to safely go-around should be available to the flightcrew, and the airplane should have the capability to go-around. The go-around must be able to be initiated at any time during the approach to touchdown. Although flight guidance system go-around capability is not required, if such go-around capability is supported by a flight guidance system, that capability should be able to be selected at any time during the approach to touchdown. If a go-around mode of a flight guidance system is activated at a low altitude where the airplane inadvertently touches the ground, the flightcrew should have access to adequate information to accomplish a safe go around, and the airplane or flight guidance system should not exhibit any unsafe characteristic as a result of an inadvertent touchdown.

c. The following factors should typically be considered when evaluating the safety of go-arounds from any point in the approach before touchdown:

(1) Go-around capability should address normal operating conditions, and may include specified non-normal conditions (e.g., engine out) down to the lowest expected operating minimum.

(2) Factors related to any geometric limitations (such as tail strike) or configuration changes (such as flap retraction, or allowing for any necessary acceleration segment) of the airplane during the transition to a go-around should be considered.

(3) Factors such as the autopilot, flight director, or autothrottle mode switching or automatic disconnect, minimizing altitude loss during transition to a go-around, and addressing any adverse consequences that might result from autopilot, flight director or autothrottle malfunction should be considered.

(4) If a go-around could result in an inadvertent touchdown, the safety of such an event should be considered. The airplane design and/or procedures used should accommodate relevant factors. Examples of relevant factors to consider include operation and acceleration characteristics of engines, failure of an engine, the operation of autothrottles, autobrakes, autospoilers, autopilot/flight director mode switching, and other systems (e.g., ground sensing logic) which could be adversely affected by an inadvertent touchdown.

(5) If the occurrence of any failure condition in the airplane or its associated equipment could preclude a safe go-around from low altitude, then such failure conditions should be identified. In such a case, a minimum height may be specified from which a safe go-around was demonstrated if the failure occurs. If the failure occurs below the specified height, pilots should be made aware of appropriate procedures to be used, and the effects or consequences of any attempt to go-around.

d. If necessary, information should be provided to the flightcrew concerning appropriate procedures for low altitude go-around. If the ability to conduct approach and landing operations with an engine inoperative using low minima are intended (e.g., minima below an MDA or DA(H) of approximately 250 ft. HAT), or if procedures for an engine failure during a low altitude go-around require special consideration or are significantly different than for any other go-around, then flightcrew procedures to safely conduct such an engine-out go-around should be addressed. If necessary, suitable information to safely conduct such a low altitude go-around should be provided to the flightcrew (e.g., flap configurations and flap retraction procedures, appropriate acceleration to a suitable go-around speed, appropriate use of auto-feather capability).

5.15. Excessive Deviation Alerting. Some method is recommended for being able to detect excessive deviation of the airplane laterally and vertically during approach, and laterally during rollout, as applicable. The method used should not require excessive workload or undue attention. This provision does not require a specified deviation warning method or annunciation, but may be addressed by parameters displayed on the ADI, EADI, or PFD. When a dedicated deviation warning is provided its use must not cause excessive nuisance alerts.

5.16. Rollout Deceleration Systems or Procedures for Nonprecision, Category I, or Category II.

5.16.1. Stopping Means. A means to determine that an airplane can be reliably stopped within the available length of the runway, considering ambient conditions, is recommended for any operation.

5.16.2. Antiskid Systems. Airplanes authorized for Nonprecision, Category I, or Category II do not have specific antiskid system installation or use requirements beyond those specified in the applicable AFM, applicable FAA Master Minimum Equipment List (MMEL) and MEL, and applicable field length operating rules.

5.17. Engine Inoperative Category II Capability. The following criteria are applicable to airplane systems intended to qualify for "engine inoperative Category II" authorizations. Airplanes demonstrated to meet provisions of Appendix 2 with an "engine inoperative" and that have reference to engine inoperative Category II capability in the FAA approved AFM are considered to meet the provisions listed below. Other airplanes which have an AFM showing only all-engine Category II capability may be operationally demonstrated for engine inoperative Category II capability through the proof of concept process.

a. The AFM or equivalent reference (e.g., operators manual) must suitably describe demonstrated approach and missed approach performance for the engine inoperative configuration, and the airplane must meet pertinent criteria otherwise required for all-engine Category II or equivalent criteria. Suitable performance information should also be available to the pilot and, if applicable, the airplane dispatcher, to ensure safe landing capability in the anticipated configuration and with anticipated speeds, and to establish safe go-around capability from DA(H) and, if applicable, for a balked landing from the TDZ (e.g., equivalent to an obstacle clearance take-off procedure).

b. When assessing engine-out Category II capability, the following exceptions to all-engine Category II criteria may be used:

(1) The effects of a second engine failure when conducting Category II operations with an engine inoperative need not be considered;

(2) Crew intervention to re-trim the airplane to address thrust asymmetry following engine loss may be permitted;

(3) Alternate electrical and hydraulic system redundancy provisions may be acceptable, as suited to the type design (e.g., bus isolation and electrical generator remaining capability must be suitable for the engine out configuration);

(4) Requirements to show acceptable approach performance may be limited to demonstration of acceptable performance during engine-out flight demonstrations (e.g., a safe approach to minima); and

(5) Approach or Landing system "status" should accurately reflect the airplane configuration and capability.

c. Suitable information about flight guidance system capability must be available to the flightcrew in flight, particularly at the time of a "continuation to destination" or "diversion to alternate" decision. This is to determine that the airplane can have an appropriate Category II approach capability when the approach is initiated (e.g., Non-normal checklist specification of expected configuration during approach, autopilot or flight director status annunciation of expected mode capability).

d. The operator should consider system performance in appropriate weather conditions (e.g., winds, turbulence, or wind gradients) to make a determination as to whether any weather related restrictions or limitations are appropriate.

5.18. Airborne System Operational Evaluation and Approval. Nonprecision, Category I, and Category II airborne systems should be evaluated IAW the applicable airworthiness criteria contained in Appendix 1 and 2 or equivalent criteria, during type certification approval and be able to conduct Nonprecision, Category I, or Category II operations IAW the operational concepts discussed in Paragraph 4.

> **NOTE: If airworthiness approval has been given based upon previous airworthiness criteria, airborne equipment which is shown to meet the operational demonstration criteria in the applicable subparagraphs below, may also be acceptable for Nonprecision, Category I, or Category II landing minima if it is demonstrated that this equipment permits safe Nonprecision, Category I, or Category II operations. Such operations may be approved on a case-by-case basis by AFS-400.**

5.18.1. Airborne Equipment Operational Validation. The applicant should provide an acceptable test and evaluation plan which establishes satisfactory performance of the flight guidance system for either the Nonprecision, Category I, or Category II operations intended, as applicable. To be acceptable, the applicant should conduct an appropriate number of approaches and missed approaches, or other applicable operations for representative instrument procedures to be flown. For such assessments under this provision, an applicant may be considered to be an operator, a group of operators, or an airplane manufacturer or avionics manufacturer in conjunction with one or more operators.

5.18.1.1. Category II Assessments. For Category II, the applicant should typically be expected to perform at least 300 successful approaches to appropriate Category II DA(H) minima, in each airplane type intended. The 300 approaches may be allocated to several variants within a type if the flight guidance systems used by each variant are the same or similar. If a related or similar airplane type is configured with the same or a similar flight guidance system and is already approved for Category II, or for special case considerations such as consideration of an engine inoperative Category II approach, the number of approaches for a particular type or variant may be reduced by an appropriate amount depending on the degree of system similarity, flight guidance performance similarity, or airplane similarity, as determined appropriate by AFS-400. Approaches may be accomplished in line operations, during training flights, or during specific demonstration flights, or in any combination. Not less than 90 percent of the total demonstrated approaches conducted should be successful. No unsafe approaches or missed approaches should occur. (See 5.18.2.3 for a definition of a successful approach). Approaches should be accomplished IAW the following criteria:

a. A minimum of three facilities/runways should be used during the demonstrations, unless Category II operations will be conducted only at fewer than 3 facilities by that operator. At least 10 percent of the total number of approaches should be conducted on each of at least three of the facilities selected. The number of approaches conducted on additional facilities may be at the applicant's discretion.

b. At least some approaches should be accomplished using facilities approved for Category II or Category III procedures. However, at the applicant's option, demonstration may be made using facilities used only for Category I procedures when classified at least 1/D/2. (Point "D" is 12 ft. above the runway centerline and 3000 ft. from the runway threshold in the direction of the localizer.) (See Order 6750.24)

c. No more than 15 approaches per day should be conducted on a single facility.

d. No more than 60 percent of the approaches should be conducted in any single airplane, unless the operator has 3 or fewer airplanes to be evaluated, and performance of the other airplane may be considered to be equivalent.

e. Where an applicant has different variants of a type airplane which utilize the same or similar flight guidance system, the applicant should ensure that each of the variants can meet the necessary performance criteria.

f. If flight director performance is to be assessed, a representative number of pilots should be used to conduct the necessary approaches. No single pilot should perform more than 20 percent of the approaches, unless a small total number of pilots assigned to the airplane type requires the use of a greater percentage.

g. An acceptable sample of the approaches conducted should be observed by an FAA Aviation Safety Inspector or other suitably qualified evaluator(s) (e.g., a check airman representatives of the operator, an APD or equivalent, or representatives from the airplane or avionics manufacturer), as determined acceptable by the FAA.

5.18.1.2. Flight Technical Error (FTE) Assessments. Flight Technical Error (FTE) assessments for approach or missed approach, or other defined operations, may be made by an airplane manufacturer, an avionics manufacturer, or an operator to establish alternate levels of expected FTE to be used for navigation system or procedure authorization. An airplane manufacturer or avionics manufacturer seeking to demonstrate alternate levels of FTE without involvement of an operator would normally be expected to do so as part of a TC or STC process (see Appendix 1 and 2). Alternate levels of FTE may then be applied to instrument procedure development or authorization, in lieu of standard assumed FTE values, when the assumptions or conditions of the alternate FTE levels can be met or satisfied.

a. FTE levels may be established by analysis (e.g., of existing data), by simulation (e.g., in a suitable flight training simulator), through flight verification (e.g., data collected from flight demonstration(s) with an appropriately configured airplane), or in any combination of these methods. Regardless of the method(s) used, sufficient assessment should take place to ensure that any resulting FTE information or values are valid for the navigation conditions or procedures to which they are to be applied. The assessment should key to types of procedures to be flown, appropriately consider normal and non-normal operations, should address pilot capability or system variability to the extent necessary, and should have sufficient repeatability to have confidence in the FTE level(s) that result.

b. Any FTE assessment related exceptions to industry criteria found in sources such as RTCA DO-236A for RNP should be clearly identified, if necessary (e.g., navigation systems for which 22 nm constant radius turns are not intended to be applicable).

5.18.2. Data Collection and Analysis for an Airborne System Evaluation.

5.18.2.1. FTE Data Collection and Analysis. For an FTE assessment demonstration, sufficient data should be collected to establish the suitability of the levels of FTE sought. The data collection and consequent analysis should match and at least consider the types of procedures to be flown (e.g., representative leg types and leg geometry), airplane configurations to be used (e.g., map display, flight director, autopilot), representative environmental conditions, pertinent normal or non-normal conditions, and representative pilot qualification and experience. Data collection may be from a dedicated FTE assessment, or from data collected during line operations, if appropriate conditions are experienced (e.g., weather) and assumptions satisfied (e.g., pilot sample variability). FTE data collection and analysis may separately address flight on stabilized portions of straight segments, and flight during curved segments or during leg to leg captures. Use of statistical methods for analysis of data is acceptable, but is not necessarily required (e.g., for treatment of certain non-normal conditions). The analysis methods or techniques to be used by the applicant and any demonstration program to be used should be determined to be acceptable to FAA prior to commencement of the FTE assessment program.

5.18.2.2. Data Collection for a Category II Demonstration. For a Category II system suitability demonstration, each applicant or designated representative should provide the information listed below, as necessary and as requested by the CHDO. This information should be related to performance of the airborne flight guidance system and display system regardless of whether an attempted approach demonstration is successful, unsuccessful, or discontinued. The information, along with recommendations and any clarifying information regarding unsuccessful or discontinued approaches should be provided to the FAA CHDO:

a. Specify the total number approaches attempted, the number successful, and the number of and reasons for unsuccessful or discontinued approaches, if known.

b. If an approach is discontinued, specify the height above the runway at which the approach was discontinued.

c. Specify the acceptability of lateral position, vertical position, track, vertical path/vertical speed, speed error, and pitch trim acceptability at 200 ft. HAT, 100 ft. HAT or at DA(H), and note if the approach was in any way inconsistent with continuing an approach to a normal landing within the touchdown zone.

d. Specify the NAVAIDs and runway facilities used, and the reported weather and wind conditions in which the assessment was conducted.

e. Evaluate the tracking performance stability, and suitability of the flight director or autopilot, as applicable, for the intended operation.

f. If not otherwise based on data recording, the evaluator(s) should note and record the lateral and vertical position of the airplane relative to the localizer and glide slope at least at the 200 ft. HAT, 100 ft. HAT or at DA(H), and the estimated runway touchdown point achieved consistent with following the flight guidance system, as applicable to the system used.

g. If unable to initiate an approach due to a deficiency in the airborne equipment, note the reason for the deficiency and any recommendation for addressing the deficiency.

h. Provide any other relevant associated recommendations or circumstances.

NOTE: Unsuccessful approaches attributed solely to Air Traffic Service (ATS) circumstances may be excluded from the data (e.g., flights vectored too close to a final fix or at large angles preventing adequate localizer and glide slope capture; termination of an approach at the request of an Air Traffic Facility or due to an amended air traffic clearance; evidence of inappropriate ILS critical area protection). Also, unsuccessful approaches may be excluded from consideration due to faulty NAVAID or non-airplane sensor signals. Airborne system failures attributed to maintenance failures or maintenance factors should be documented for subsequent joint resolution by FAA and the operator.

5.18.2.3. Definition of a Successful Approach for a Category II Demonstration. For the purpose for the airborne system suitability demonstration for Category II, a successful approach is one in which, at least at the 100 ft. HAT point or DA(H), through touchdown, meets the following criteria:

a. The airplane is continuously in a position to complete a normal landing using normal maneuvering. Typically this is considered to require that below 200 ft. HAT the flight deck is positioned within and is tracking to remain within, the lateral confines of the extended runway.

b. The deviation from glide slope does not exceed ± 75 microamps (usually 1/2 scale) as displayed on the ILS, MLS, GLS, or equivalent system/indicator at least down to the DA(H). Below the DA(H) a normal approach path is followed and a normal flare occurs, with a landing safely within the touchdown zone at normal sink rates and attitudes.

c. The indicated airspeed, track, vertical speed, alignment and heading are satisfactory. Indicated air speed does not exceed ± 5 knots of planned approach airspeed but may not be less than computed threshold or reference speed.

d. No unusual maneuvers or excessive attitude changes or attitude rates occur.

e. The airplane is generally in trim so as to preclude any excessive control forces.

5.19. GPWS or TAWS Interface. Airborne equipment used for approach should interface with GPWS and TAWS to prevent false alerts. This is to ensure nuisance free operation at routine airports. Special procedures may be used for non-normal procedures or at airports with unusually difficult underlying terrain, or other such factors.

5.20. Flight Data Recorder (FDR) Interface. Airborne equipment used for approach should have appropriate interfaces with or compatibility with flight data recorders, and if applicable cockpit voice recorders (e.g., alerting audio audibility on the Cockpit Voice Recorder (CVR)).

5.21. Take-off or Dispatch, with Inoperative Navigation Receivers, Instruments, or Displays for Nonprecision, Category I, or II. Notwithstanding the airborne equipment installation provisions of Paragraphs 5.2 and 5.3 above, and IAW any other FAA applicable MMEL and MEL provisions (e.g., as specified by the FAA FOEB or Flight Standardization Board (FSB)), a pilot may depart or an operator may dispatch an airplane for Nonprecision, Category I, or Category II using the following guidelines.

5.21.1. Inoperative System Departure or Dispatch For Nonprecision and Category I. For departure, or dispatch for Nonprecision and Category I, if applicable, two navigation receivers are typically required, with each suitable for the route of flight and expected approaches to be conducted (e.g., dual ILS, if flying a route based on expected use of ILS for landing).

a. If the flight is based on use of a planned approach procedure that specifically requires dual navigation capability (e.g., /E required, or dual NDB required, or dual VOR required) then the two pertinent systems are required for take-off or dispatch.

b. If an approach procedure planned for use is not precluded from being conducted using one navigation source (e.g., one NDB, one FMS, one ILS) a minimum of one navigation receiver, of each type required for the intended flight is required. Flight guidance (deviation) from that navigation receiver should be able to be displayed at or be visible to each required pilot station, for each type of facility(s) intended for landing. Use of this provision requires considering subsequent failure of the one system intended for use (e.g., the ILS) and the need to be able to safely use any alternate remaining navigation system(s) (e.g., VOR or RNAV) while enroute, during approach, or during missed approach. In any instance, after the first failure in-flight, there must still be another suitable navigation capability available to the airplane to safely land. The other navigation capability required above may be based on use of a different NAVAID type, use of acceptable RNAV capability, or use of an alternate airport with a different type of instrument procedure.

c. Instruments, or displays, or display elements may be inoperative if, considering the remaining instruments or displays, each pilot can accomplish that pilot's respective assigned flightcrew duties for flying and monitoring the flight (e.g., failure of an ILS situation information display on the F/O's ADI or PFD may be permissible if that information or equivalent is available by other acceptable means - such as by using the F/O's HSI LOC or ND LOC indication in lieu of the ADI LOC indication). When considering inoperative component(s), subsequent failure of any single additional instrument, or display, or display component must not put the airplane or crew in an unsafe situation for which the pilots cannot safely compensate (e.g., it is determined to be acceptable in the above example that after a subsequent failure the F/O will be able to acceptably monitor the Captain's corresponding instruments, or standby instruments).

5.21.2. Inoperative System Departure or Dispatch For Category II. For departure, or dispatch, for Category II, a minimum of two LOC or GLS navigation receivers of each type to be used are normally required for Category II. Flight guidance (deviation) from the receivers to be used should be able to be independently displayed at or be visible to each respective pilot station. For ILS glide slope, only one receiver need be operative for departure or dispatch, if that receiver is a self monitored receiver with reliable failure indication, if the receiver information can be displayed at each pilots station, and if any other systems required for the Category II minima do not depend on having dual glideslope capability available (e.g., autoland, alerting and warning or monitoring systems).

a. Use of the "departure or dispatch with a single glideslope receiver" provision requires considering subsequent failure of the one GS system intended for use while enroute or on approach, and the need to be able to safely use alternate remaining navigation system(s) to safely land, after failure of the glideslope receiver in-flight.

b. Instruments and displays provisions are the same as for Category I, except that at least one operative radar altimeter must be provided, and that one radar altimeter must at least be able to be displayed at each pilot station, or be easily visible to each pilot station.

NOTE: For Category II minima, if minima are intended to be based on use of an Inner Marker in lieu of a radar altimeter(s), and if the operator is not otherwise precluded from using the Inner Marker as a means to establish Category II minima, the radar altimeter need not be operative for take-off or dispatch for purposes of establishing landing minima (e.g., for DA(H)). This provision does not address other MMEL/MEL provisions that may otherwise independently apply to radar altimeter availability, however, such as for appropriate GPWS function.

c. In addition to instruments and displays for Category II, there must be acceptable ice and rain removal protection available for the expected conditions during approach (e.g., windshield anti-ice for icing conditions, windshield wipers or equivalent for rain).

5.21.3. Inoperative System Departure or Dispatch For Either Nonprecision, Category I, or Category II.

a. For departure or dispatch for either Nonprecision, Category I, or II, for Electronic Flight Instrument Service (EFIS) airplanes that have capability to switch entire display formats to different flight deck display locations, these systems typically may be dispatched with an inoperative display, or with displays in alternate locations. For an alternate location, each pilot must be able to acceptably perform respective PF or PNF duties for approach and missed approach. Following failure of an additional display or display in an alternate position, the airplane must still be able to be safely flown and landed using available instrument approach NAVAID capability and remaining displays.

b. Operators should ensure that planned operations consider any pertinent AFM or Flightcrew Operating Manual (FCOM) provisions for flight guidance system use that may relate to inoperative components (e.g., altimeter source, navigation source, or instrument source switching, and available flight director or autopilot modes, as applicable).

5.22. Continuation of Flight After Navigation System Failure Enroute, or During Approach, for Nonprecision, Category I, or II. Notwithstanding the airborne equipment installation provisions of Paragraphs 5.2 and 5.3, MMEL and MEL provisions of Paragraph 5.21 above, and any other FAA applicable FSB provisions for the type airplane, a pilot may continue en route or initiate an approach to Nonprecision, Category I, or Category II minima using the following guidelines.

5.22.1. Continuation of a Flight After Failures For Nonprecision and Category I.

a. The operator should establish a policy addressing typical failure conditions for which initiation or continuation of an approach in low visibility conditions is considered acceptable (e.g., failure of a single flight director, FCC, or instrument, for which switching to a an alternate or common source still provides adequate information). Operators should also describe typical conditions for which the operator would expect that a pilot would divert to a different airport with better weather conditions, if possible (e.g., for complex engine or hydraulic failures where flight guidance or go-around performance may be significantly degraded).

b. Unless dual capability is specifically required for a particular procedure (e.g., /E required, dual NDB required), for initiation or continuation of approach, a minimum of at least one navigation receiver or sensor of each type required for the intended approach procedure is required. If an approach is initiated with only one receiver or sensor, the pilot should, to the extent possible, consider the potential consequence of subsequent failure of that system or sensor.

5.22.2. Continuation of a Flight After Failures For Category II.

a. For continuation en route or initiation of an approach, a minimum of one LOC or GLS navigation receiver of each type to be used is normally required for initiation or continuation of Category II approach. The receiver's displacement indications, if applicable, should, however, be able to be independently displayed at or be visible to each respective pilot station, for each type of facility(s) intended for landing (e.g., ILS, MLS or GLS). For ILS glide slope, only one receiver need be operative for approach if the receiver information can be displayed at each pilots station, and if any other systems required for the Category II minima do not depend on having dual glideslope capability available (e.g., autoland, alerting and warning or monitoring systems).

b. Instruments and displays provisions are the same as for Category I, except that at least one operative radar altimeter must be provided, and that one radar altimeter must at least be able to be displayed at each pilot station, or be easily visible to each pilot station.

> **NOTE: For Category II minima, if minima are intended to be based on use of an Inner Marker in lieu of a radar altimeter(s), and if the airplane and crew are not otherwise precluded from using the Inner Marker as a means to establish Category II minima, the radar altimeter need not be operative for approach, for purposes of establishing landing minima (e.g., for DA(H)).**

c. In addition to suitable instruments and displays, there must be acceptable ice and rain removal protection available for the expected conditions during approach (e.g., windshield anti-ice for icing conditions, windshield wipers or equivalent for rain).

5.22.3. Continuation of a Flight After Failures For either Nonprecision, Category I, or Category II. If a flight is to be continued to destination and the originally planned instrument approach procedure(s) (IAP) used after a failure enroute, or if an approach is to be continued, the pilot should consider the consequence to and alternatives available for the flight if remaining navigation receiver or sensor capability should subsequently fail.

a. For EFIS airplanes that have capability to switch entire display formats to different flight deck display locations following a failure, these systems typically may be switched to an operative display, or display in an alternate location. For a failed display or an alternate location, each pilot must be able to acceptably perform respective PF or PNF duties for approach and missed approach. Following failure of an additional display or display in an alternate position, the airplane must still be able to be safely flown and landed using available instrument approach NAVAID capability and remaining displays.

b. Pilots should ensure that planned operations consider any pertinent AFM or FCOM provisions for flight guidance system use that may relate to inoperative components (e.g., altimeter source, nav source, or instrument source switching, and available flight director or autopilot modes, as applicable).

c. A pilot exercising emergency authority may deviate from the above or any other provisions of this AC to the extent necessary to ensure safe flight and landing.

6. PROCEDURES.

6.1. Operational Procedures. Appropriate operational procedures based on the approved operator program should be addressed. Operational procedures should consider the pilot qualification and training program, airplane flight manual (AFM), crew coordination, monitoring, appropriate take-off and landing minima including specification of either a DA(H) or MDA, as applicable, for landing, crew call-outs, and assurance of appropriate airplane configurations. The operator's procedures for instrument approaches landings should be consistent with AFM provisions specified during airworthiness demonstrations. Suitable operational procedures must be implemented by the operator and be used by flightcrews prior to conducting instrument approach operations.

6.1.1. Crew Coordination. Appropriate procedures for crew coordination should be established so that flight crewmember can carry out their assigned responsibilities. Briefings prior to the applicable take-off or approach should be specified to ensure appropriate and necessary crew communications. Responsibilities and assignment of tasks should be clearly understood by crewmembers. Tasks should be accomplished consistent with the operator's specified provisions for the airplane type or variant and each crewmember position as approved by the POI (duties of each pilot, monitored approach, etc.).

6.1.2. Monitoring. Operators should establish appropriate monitoring procedures for each type of instrument approach, landing, and missed approach. Procedures should ensure that adequate flightcrew attention can be devoted to control of airplane flight path, displacements from intended path, mode annunciations, failure annunciations and warnings, and adherence to minima requirements associated with DA(H) or MDA.

a. In the event that a "monitored approach" is used, (e.g., where the first officer is responsible for control of the airplane flight path by monitoring of the automatic flight system) appropriate procedures should be established for transfer of control to the pilot who will be making the decision for continuation of the landing at or prior to DA(H) or MDA.

b. Monitoring procedures should not require a transfer of responsibility or transfer of control at a time that could interfere with safe landing of the airplane. Procedures for calling out failure conditions should be pre-established, and responsibility for alerting other flight crewmembers to a failure condition should be clearly identified.

6.1.3. Applicability of a DA, DH, MDA, or MDH.

a. General.

(1) Instrument approach operations have limitations related to the minimum altitude or height to which a descent may continue or by which a missed approach must be initiated if the required visual references (e.g., 14 CFR section 91.175) to continue the approach have not been established. The published minimum altitude or height is related to assurance of clearance over terrain or obstacles, airborne instrumentation and equipment, NAVAIDs, and visual aids. Such a minimum altitude or height is usually specified as a Decision Altitude (DA), Decision Height (DH), Minimum Descent Altitude (MDA), or Minimum Descent Height (MDH). The U.S. equivalent minima to be used for international minima specified in other terms are also described below for various types of approaches.

(2) The lowest permissible DA(H) or MDA(H) for any approach should not be lower than the most restrictive of the following, as applicable:

- Minimum height or altitude published or otherwise established for the instrument approach
- Minimum height or altitude authorized in OpSpecs for the approach
- Minimum height or altitude authorized for the flightcrew
- Minimum height or altitude authorized for the operator, airplane, and airborne equipment
- Minimum height or altitude permitted by operative airborne equipment and NAVAIDs
- Minimum height or altitude for which required NAVAIDs can be relied upon*
- Minimum height or altitude which provides adequate obstacle clearance*
- Minimum altitude which provides compensation for extremely cold temperatures, if applicable**

***NOTE: Normally addressed by the published instrument approach procedure.**

****NOTE: Applicable only when an operator has a procedure to correct altimeter errors for extremely cold temperatures (Typically less than -22F/-30C)(See table 6.2.10-1).**

b. DA(H). The DA "altitude" value is measured by a barometric altimeter, and is the determining factor for descent minima for xLS and LNAV/VNAV approach procedures. The DH "height" value specified in parenthesis is typically a radio altitude (RA) equivalent height above the TDZ elevation (HAT) and does not necessarily reflect actual height above underlying terrain. Where a Middle Marker (MM) beacon is installed, it may be used as advisory information, confirming a barometrically determined DA(H) that is coincident with the glide slope altitude at that point.

(1) For a Category I xLS procedure and an RNAV procedure with VNAV minima, a DA is typically used as the primary approach minima. For Category I a decision height (DH) is not used. For RNAV approaches with VNAV minima which use

published VNAV descent paths to the runway threshold, a DA(H) may be specified instead of a MDA(H). Criteria and procedures authorizing a DA in lieu of an MDA for certain existing instrument approach procedures meeting specified obstacle assessment provisions are contained in HBAT 99-08/HBGA 99-12. For procedures with minima based on a DA, the DA is specified as a decision altitude referenced to mean sea level (MSL) using QNH altimeter settings. While the (H) element of the DA(H) is typically advisory for such procedures, in certain circumstances the (H) value may be the basis for minima, such as when a QFE referenced barometric altimeter setting is used.

(2) For a Category II procedure, a DH specified in terms of an RA value is controlling and any associated barometric altitude value shown in a procedure is considered to be advisory. Procedures that have "Radio Altitude Not Authorized (RA NA)" due to irregular pre-threshold terrain, use the first indication of arrival at the "inner marker" as a means to establish DH. However, an operator may elect to use either the DH or the DA, which ever comes first, as the means for minima determination.

(3) Foreign countries use either a DA or a DH, with a DH-based on a direct specification of DH, or on a corresponding RA value. Other expressions of minima equivalent to a decision altitude (DA) or decision height (DH) may also be encountered, such as when an obstacle clearance altitude (OCA), obstacle clearance height (OCH), or obstacle clearance limit (OCL) is specified, and is to be treated as a corresponding DA or DH. OCA, where used, is referenced to a barometric altitude (MSL). OCH and OCL are referenced to height above either the elevation of the airport, the elevation of the touchdown zone, or the elevation of the landing threshold.

c. MDA, MDH.

(1) For instrument approaches other than ILS, MLS, GLS, or RNAV approaches with VNAV minima (e.g., Nonprecision approaches) an MDA is typically specified. Procedures that are <u>not based</u> on use of vertical guidance (e.g., VOR, NDB, LOC BC) use the barometrically based MDA for minima determination. Radio altitude, if provided, is advisory. The MDA represents the minimum altitude in an approach to which descent may continue, until either the required visual reference is established and the airplane is in a position to continue the descent to land using normal maneuvering, or until reaching the specified missed approach point. The MDA(H) "Altitude" value is typically measured by a barometric altimeter, and is the determining factor for descent minima for approaches other than ILS, MLS, GLS, or RNAV approaches with VNAV minima Category I instrument approach procedures. The "Height" value specified in parenthesis is typically a radio or radar altitude equivalent height above the touchdown zone (HAT), and is used only for advisory reference. This height value does not necessarily reflect actual height above underlying terrain. Minima may specify height above touchdown (HAT), height above airport (HAA), minimum descent height (MDH), obstacle clearance altitude (OCA), obstacle clearance height (OCH), or obstacle clearance limit (OCL).

NOTE: The use of a MDH is not authorized in the U.S.

(2) Some foreign countries use MDA, HAT, and HAA values based on earlier versions of U.S. TERPS criteria. OCA, OCH, and OCL are used in countries having procedures established IAW ICAO PANS-OPS. Although ICAO PANS-OPS now does not use OCL, some procedures still use OCL criteria from previous versions of PANS-OPS. Some countries, in addition to OCA and OCH, provide MDA and MDH. MDA and OCA are barometric flight altitudes referenced to mean sea level (MSL). HAT, HAA, MDH, OCH, and OCL are radio or radar altitudes referenced to either the elevation of the airport, the elevation of the touchdown zone, or the elevation of the landing threshold. In addition, for international operations, U.S. operators should:

(a) Use an OCA as an MDA.

(a) Use an OCH, OCL, or HAT as an MDH for "straight-in" approach procedures.

(c) Use an OCH, OCL, or HAA as an MDH for "circling" approach maneuvers.

6.1.4. Crew Callouts. Altitude/Height callouts should be developed, implemented, and used for Nonprecision, Category I, and Category II operations. When more than one category of operation is used (e.g., Category I or II) callouts should be compatible, consistent, and preferably common to as many categories of operation as practicable.

a. Callouts may be accomplished by the flightcrew or may be automatic (e.g., using synthetic voice call-outs or a tone system). Typical call-outs acceptable for Nonprecision, Category I, or Category II include the following:

- "1000 ft." above the touchdown zone
- "500 ft." above the touchdown zone
- "approaching minimums"
- "at minimums," as applicable
- [any pertinent visual reference(s) observed, and resulting flightcrew action], as applicable (e.g., "runway in sight,... landing")
- key altitudes during flare, (e.g., 50, 30, 10) or Automatic Flight Guidance System (AFGS) mode transitions (e.g., flare, rollout)
- as appropriate, auto spoiler, reverse thrust deployment and autobrake disconnect

b. Combinations of these calls may also be used as appropriate. In any event, the calls made by the flightcrew should not conflict with the automatic systems or auto call-outs of the airplane, and conversely the configuration selected for the airplane should not conflict with expected call-outs to be made by the flightcrew. Compatibility between the automatic call-outs and the crew call-outs must be ensured. The number of call-outs made, either automatically, manually or in combination, should not be so frequent as to interfere with necessary crew communication for abnormal events.

c. Also, call-outs should be specified to address any non-normal configurations, mode switches, failed modes, or other failures that could affect safe flight, continuation of the landing, or the accomplishment of a safe missed approach. Any use of crew initiated call-outs at heights below 100 ft. during flare should ensure that the call-outs do not require undue concentration of the non-flying pilot on reading of the radio altimeter rather than monitoring the overall configuration of the airplane, mode switching, and annunciations. Automatic altitude call-outs or tones are recommended for altitude awareness, at least at and after passing DA(H) or MDA(H).

6.1.5. Airplane Configurations.

a. Operational procedures should accommodate any authorized airplane configurations that might be required for any instrument approach or missed approach procedure. Examples of configurations that operational procedures may need to accommodate include:

(1) Alternate flap settings;

(2) Use of alternate AFGS modes or configurations (e.g., with or without autopilot(s) or flight director(s), autoland, HUD);

(3) Inoperative equipment provisions related to engine(s) inoperative, or the minimum equipment list, such as a non-availability of certain, inoperative instruments (e.g., Primary Flight Display (PFD), radio altimeter), air data computers, hydraulic systems or instrument switching system components;

(4) Availability and use of various electrical system components (e.g., generator(s) inoperative), alternate electrical power sources (e.g., Auxiliary Power Unit (APU)) if required as a standby source; and

(5) If applicable, describing the relationship of approach minima to any decision or commit points for critical airplane configurations that are identified by the operator (e.g., two engines inoperative procedures for three or four engine airplanes, or abnormal flight control configuration procedures).

b. Operational procedures required to accommodate various airplane configurations should be readily available to the flightcrew to preclude the inadvertent use of an incorrect procedure or configuration. Acceptable configurations for that operator and airplane type should be clearly identified so that the flightcrews can easily determine whether the airplane is or is not in a configuration to initiate an instrument approach using a pertinent instrument approach procedure.

6.1.6. Compatibility between Category I, Category II, and Category III Procedures.

a. The operator should ensure that to the extent possible, flightcrew and operational procedures for Category I and Category II are consistent with the procedures for that operator for Category III, particularly to minimize confusion about which procedure should be used in variable weather.

b. The operator should to the extent practical, minimize the number of procedures that the crew needs to be familiar with for low visibility operations so that, regardless of the landing category necessary for an approach, the correct procedures can be used consistently and reliably.

6.1.7. Operational Procedure Considerations During Non-Normal Operations. When procedures or configurations have been specified for non-normal situations, flightcrews are expected to apply those procedures and use good judgment in making the determination of any appropriate adjustments to safely use an IAP. This may include identifying any necessary adjustments to DA(H), MDA, approach path, missed approach path, or required visibility believed to be necessary (e.g., assessing the climb gradient that can be achieved, identifying a safe engine out lateral and vertical flight path, requesting an appropriate length of final approach). Guidelines for non-normal configurations, situations, or procedures may be provided by the AFM or by the operator. Flightcrews are expected to be familiar with these guidelines and apply them to the extent practical.

a. When procedures or configurations have not been specified for a non-normal situation or configuration, flightcrews are expected to use good judgment and select the safest course of action in making the determination of appropriate configurations or margins for an approach. The decisions to initiate, continue, or to discontinue an approach, divert to an alternate, and any adjustments to minima should be made considering relevant factors such as:

- Seriousness of the emergency
- Failure status of the airplane
- Potential for unknown damage or further failures
- Navigation system status
- Runway, visual aid, and NAVAID status
- Procedure flight path and minima to be used
- Proximity to high terrain, obstacles, or adjacent approaching airplanes
- Potential altitude loss, flight path required, or cleanup altitude needed to change configuration and accelerate for a missed approach
- Obstacle clearance during transition to a missed approach (including the possible need to reject the landing from below DA(H) or MDA(H)
- Fuel on board
- Distance and suitability of alternate airports
- Likelihood of changing weather, NAVAID, or runway conditions

b. It is not the intent of this AC to comprehensively define guidelines for each circumstance that might be possible

(e.g., serious in-flight fire, minimum fuel). It should be noted, however, that flightcrew have both the authority and responsibility to consider relevant factors, such as those identified above, when deciding the safest course of action. If doubt exists on a course of action (e.g., initiating or continuing an approach with conditions potentially below minima), it is the flightcrews responsibility to exercise any necessary emergency authority to ensure safe flight.

6.2. Nonprecision, Category I, or Category II Instrument Approach Procedures.

6.2.1. Acceptable Procedures for Nonprecision and Category I. Procedures acceptable for a Nonprecision and Category I authorization for a U.S. Operator in the U.S., or at foreign airports, under provisions of part 121, 125 or 135, or for a Foreign Operator under provisions of Part 129 at U.S. Airports, are those listed in this AC and any others found acceptable to FAA and listed in Standard OpSpecs, Part C.

6.2.2. Acceptable Procedures for Category II. Procedures acceptable for a Category II authorization for a U.S. Operator in the U.S., or internationally, under provisions of part 121,125 or 135, or for a Foreign Operator under provisions of Part 129 at U.S. Airports, are those listed in this AC and any others found acceptable to FAA and listed in Standard OpSpecs, Part C.

6.2.3. Standard Obstacle Clearance Requirements for Approach and Missed Approach. Standard and Special approach and missed approach criteria for obstacle clearance for normal operations are as specified in Order 8260.3, United States Standard for Terminal Instrument Procedures (TERPS), associated 8260 series orders, or as referenced in FAA Air Traffic criteria for terminal procedures (Order 7100.11, Flight Management System Procedures Program), or for foreign airports, ICAO PANS-OPS.

a. Standard VNAV criteria is specified in FAA order 8260.40. Regardless of criteria used, the operator should ensure appropriate consistency between obstacle clearance criteria, used for take-off, en route operations, terminal procedures, instrument approach procedures, engine inoperative procedures, and driftdown procedures, as applicable.

b. Other obstacle clearance criteria may be requested for use by an applicant and authorized by FAA, for specific applications (e.g., international operations, operations at military facilities, disaster relief). When other criteria are used, related compensating factors are typically considered, to ensure equivalent safe terrain or obstacle clearance.

c. For non-normal operations (e.g., engine inoperative), criteria equivalent to that specified in Federal Aviation Regulations for take-off (e.g., section 121.189) may be applied for those portions of an approach or missed approach not otherwise addressed by procedure design for normal operations (e.g., engine out missed approach gradients, or engine inoperative flap retraction and acceleration segments, or a rejected landing climb back to procedurally protected airspace after loss of visual reference at an airport with significant nearby obstacles or mountainous terrain).

6.2.4. Irregular Pre-threshold Terrain Airports. Irregular pre-threshold terrain airports identified by a 14 CFR part 97 procedure, or by FAA Order 8400.8, must be evaluated IAW FAA Order 8200.1 prior to incorporation in OpSpecs for use by air carriers operating to Category II minima. Acceptable procedures for evaluation of use of these airports may be found in of AC 120-28D, appendix 8.

> (See the FAA worldwide web site for the Category II/III Status List, for Restricted (irregular pre-threshold terrain) airports: **http://www.faa.gov/avr/afs/afs410/afs410.htm**).

6.2.5. Airport Surface Depiction for Nonprecision, Category I, or II Operations.

a. Unless otherwise authorized for a particular airport or series of airports, a suitable airport surface depiction should be available to flightcrews for each regular, provisional, alternate airport or any airport the operator could reasonably expect operations (e.g., section 121.161 Extended Range Operations with Two-Engine Airplanes (ETOPS) diversion airports, designated emergency airports), to ensure appropriate identification of visual landmarks or lighting to safely accomplish taxiing from the gate to the runway and from the runway to the gate. Airport depiction should be on an appropriate scale with suitable detailed information on gate locations, parking locations, holding locations, critical areas, obstacle free zones, taxiway identifications, runway identifications, and any applicable taxiway markings for designated holding spots or holding areas. Standard depictions provided by commercial charting services may be acceptable if they provide sufficient detail to identify suitable routes of taxi to and from the runway and gate positions for departure or arrival.

b. Electronic presentations of airport diagrams are considered an acceptable substitute for paper depictions if acceptable operational provision is made for failure of the electronic device providing the airport depiction, if each necessary flight crewmember can have access to the depiction when needed, and if equivalent scaling, orientation, chart detail, and information content is provided.

6.2.6. Continuing Instrument Approaches in Deteriorating Weather Conditions. The following procedures are considered acceptable in the event that weather conditions are reported to drop below the applicable instrument approach minima after an airplane has passed the final approach point or final approach fix, as applicable (reference section 121.651).

a. Operations based on a DA(H) may continue to the DA(H) and then land, if the specified visual reference is subsequently established by the pilot no later than the DA(H).

b. Operations based on an MDA may continue to the MDA, and then to the point of intercept of the VNAV path to the runway, to the Visual Descent Point (VDP) or equivalent, or to the MAP, then land if the specified visual reference is established by the pilot no later than point at which descent below the MDA commences.

> **NOTE: Use of a VNAV path to the runway may be conducted, providing that the airplane does not proceed beyond the MAP until visual reference with the intended runway environment is attained.**

c. For wind constraint applicability on final approach see paragraph 6.2.8.

6.2.7. IFR Approaches in Class G Airspace. An operator may be authorized to conduct IFR approaches to Nonprecision, Category I, or Category II minima in Class G airspace, if the requirements of the applicable OpSpecs are met.

a. Nonscheduled Operations. For nonscheduled operations, the Certificate Holding District Office (CHDO) must ensure that the operator's Category I or II operations program provides the policy, and direction and guidance necessary to safely conduct these operations. The CHDO must also ensure that the certificate holder's manuals cover the specific procedures which must be used, and the facilities and services which must be available and operational for the safe conduct of instrument approach operations in Class G airspace (e.g., weather reporting, advisory frequencies, and NAVAID critical area protection, as applicable).

b. Scheduled Operations. In addition to meeting the requirements for nonscheduled operations, the CHDO must ensure that the facilities and services necessary for the safe conduct of instrument approach procedures in Class G airspace are available during the times of scheduled operations, and are specified in the OpSpecs.

c. Method of Approval. The authorizations to conduct instrument approach procedures in Class G airspace are addressed by issuing Special Non-14 CFR part 97 OpSpecs.

6.2.8. Wind Constraint Applicability. When wind constraints apply to Nonprecision, Category I, or Category II procedures (e.g., an OpSpec 15 knot crosswind component limit) the limit is considered to apply to the point of touchdown. If a report of a crosswind component value greater than the limit is received while on approach, an airplane may continue an approach if subsequent wind reports indicate that the winds are within limits prior to touchdown.

6.2.9. Crosswind Component Determination at Airports with Significant Magnetic Variation (Polar Regions). Operators, flightcrews, and dispatchers (if applicable) of air carriers operating in polar regions or having ETOPS or Extended Range Operations (EROPS) alternates in these polar regions should be familiar with appropriate methods to determine wind components and particularly tailwind and crosswind components at airports with significant magnetic variation, or with runways oriented to true north. Due to ICAO Routine Aviation Weather Report (METAR), Terminal Aviation Forecast (TAF), and Air Traffic Service (ATS) Tower reported winds and runways potentially having different magnetic or true north reference, caution must be exercised where significant magnetic variation values exist, to correctly determine applicable crosswind and tailwind component limits.

6.2.10. Unusual or Extreme Temperatures or Pressures.

6.2.10.1. General Cold Temperature Considerations.

a. Appropriate "cold temperature" altitude adjustments for instrument procedure minimum segment altitudes (e.g., initial or intermediate segments) should be made when altitude errors resulting from unusually cold airport surface temperatures are considered significant, and are needed to ensure terrain or obstacle clearance. Appropriate corrections may be made by instrument procedure designers, airspace planners, Authorities, ATS, operators or pilots, as necessary. Altitude errors may be considered significant in mountainous regions when surface temperatures are below -22F/-30C, when terrain or obstacle clearance is a factor, and when temperature considerations have not otherwise been addressed by instrument procedure design. Corrections should not additionally be made by flightcrews if instrument procedures already address temperature related terrain or obstacle clearance to the degree necessary, or if ATS has addressed cold temperature considerations in their assigned clearance altitudes. Use of any altitude corrections made by flightcrews should be consistent with ATS cold temperature altitude correction policies when such policies are promulgated, and when safe clearance is ensured by those ATS policies.

b. The operator should address appropriate flightcrew and dispatch procedures (if applicable) for use of temperatures near or possibly beyond the AFM range, if operations are necessary or are reasonably expected to be conducted at or near AFM limits (e.g., runway temperatures near or above 120 degrees F or near or below -54 degrees F). The operator should also address appropriate flightcrew and dispatch (if applicable) use of temperature in degrees C, degrees F, and conversion between C and F, if necessary.

6.2.10.2. Temperatures Below Those Used in Procedure Design. In some countries, cold temperature errors are considered during procedure design, and are addressed in published instrument procedures, MEA’s, and ATS minimum clearance altitudes such as Minimum Vector Altitudes (MVA) when necessary. If temperatures are significantly below the reference temperature considered during procedure design, it may be appropriate for pilots or operators to apply altitude corrections to the specified (published or charted) procedure minimum altitudes while in flight. This may be done using an appropriate altitude correction table as provided in Table 6.2.10-1 below, or through an equivalent table or method, to ensure terrain or obstacle clearance.

6.2.10.3. Segments Which May Need to be Corrected for Temperature. Altitude corrections are particularly important on initial or intermediate approach segments in areas of mountainous terrain when there is a significant difference between true altitude and indicated altitude due to unusually cold surface temperatures. Additionally, the size of any temperature induced altitude or height error decreases in magnitude as the height above the airport surface decreases. Corrections may also be appropriate for MEA’s, MVA’s, "driftdown" flight paths in mountainous terrain, or missed approach or take-off flight paths, when extreme cold temperature effects are not otherwise considered. When a U.S. Air Traffic Facility, or international ATS facility already considers cold temperature effects in clearances, additional corrections by flightcrews should not normally be made (e.g., for a radar vector altitude clearance).

6.2.10.4. Uncorrected Procedures. In the U.S. and certain foreign countries (e.g., Canada, Northern Europe, when using ICAO criteria), cold temperature correction may need to be applied any time temperature is below ISA. When flying to such states, it is important for the operator and pilots to be aware of that state’s cold temperature instrument procedure correction policy, and to operate consistent with that policy.

6.2.10.5. VNAV Path and Visual Glide Slope Indicator (VGSI) Temperature Considerations. Pilots and operators should be aware that temperature related effects on VNAV path formulation can occur when operating well below or above ISA. For example, in extreme cold temperatures VNAV descent gradients may be more shallow than usual and visual aids (e.g., VGSI) may not display "on path" indications when visual reference is first acquired, even though the airplane is correctly flying the FMS indicated VNAV path. In such cases, pilots should be alert for the need to adjust and ensure a safe flight path. Similarly, pilots and operators should be aware that unusually shallow VNAV gradients could be lower than "step down" crossing altitudes if temperature considerations have not been addressed. For temperatures well above ISA, VNAV descent angles may be correspondingly steeper than nominal. While obstacle clearance would not be an issue, airplane descent gradient capability could be a factor if operating near descent gradient limits for the airplane (e.g., with unusual tailwind conditions at altitude, or with reduced flap settings with an engine inoperative).

6.2.10.6. Unusually Cold Temperature Operations Within the U.S. Within the U.S., an altitude additive associated with cold temperature factors are not considered by procedure designers and are not considered by airspace planners when establishing MVA’s in cold climates and mountainous areas. Cold temperature correction values may vary by location or situation. If operators have questions as to the suitability of a particular procedure in extreme cold conditions, operators may consult the appropriate FAA procedure design office through their respective POI or CMO to determine what, if any, additional precautions or adjustments may be appropriate in extreme cold temperature conditions.

6.2.10.7. Unusually Cold Temperature Operations Outside of the U.S.

a. Not all states address temperature compensation within instrument procedure development or in airspace procedure planning. If a flightcrew or operator is in doubt regarding safe obstacle clearance, additional margin should be provided (e.g., requested from ATS, if applicable). Operators may elect to coordinate with foreign authorities or ATS facilities in countries outside of the U.S. which have unusually cold temperatures to determine which procedure specified altitudes include extreme cold temperature considerations, if any, and which do not. If a pilot is in doubt as to safe altitude clearance, corrections should be considered and applied, and ATS should be advised of the use of corrected altitudes, if applicable.

b. Where temperature constraints are placed on IAP's, operators and pilots should be familiar with and properly apply those constraints. Pilots and operators should also be familiar with any temperature correction table(s) provided by the "State of the Aerodrome" (ICAO), or airplane manufacturer. For FMS, pilots should be familiar with any temperature correction methods that apply to proper FMS use, if provided.

6.2.10.8. Use of Standard Cold Temperature Correction Table. (Table 6.2.10-1). Extreme cold temperature corrections may be made within the U.S., or by U.S. operators when flying internationally, IAW the standard temperature correction table shown in Table 6.2.10-1, or through an equivalent table. International operators flying to the U.S. (e.g., part 129) may use methods acceptable to the authority of the State of the Operator, or methods equivalent to those found acceptable for US operators by FAA.

a. Table 6.2.10-1 provides altitude correction values in feet, related to reported airport surface temperature, to be added to various published instrument procedure related altitudes. The amount of altitude correction to be applied depends on the height of the published segment above the airport.

b. For example, using Table 6.2.10-1, with the following conditions:

(1) a reported airport surface temperature of -30C, and

(2) a published instrument procedure segment altitude of 1500 ft. above the airport elevation, an altitude correction of 280 ft. would apply (see highlighted values in Table 6.2.10-1).

6.2.10.9. Use of Other Cold Temperature Correction Tables. In the event that different cold temperature altitude correction table(s) or methods are provided by a "State of the Aerodrome," an airplane manufacturer, ICAO, another authority for that State, or by the operator (e.g., simplified table(s) or methods), pilots or operators may use that alternate table or method in lieu of Table 6.2.10-1. The alternate table(s) or methods should, however, ensure suitable terrain and obstacle clearance, and its use must be compatible with any applicable ATS procedure or clearance.

6.2.10.10. Altimeter Settings. Pilots and operators should be familiar with the proper altimeter settings to use. They should take necessary precautions to switch altimeter settings at appropriate times or locations, considering possible multiple sources for altimeter settings including ATS issued altimeter settings, company or airport reported settings, or settings broadcast over Automatic Terminal Information Service (ATIS), or automated settings received by radio based on AWOS, or ASOS.

6.2.10.11. Altimeter Settings (Not Recent). Pilots and operators should also take necessary precautions when using altimeter settings that may not be recent, or settings from remote locations, or rapidly varying settings, particular at times when pressure is reported or is expected to be rapidly decreasing.

6.2.10.12. Precautions For Unusually High or Low Temperatures or High or Low Pressures. Airplane performance or procedure adjustments may need to be considered for unusually high or low temperatures or high or low pressures (e.g., temperatures or pressures above or below available AFM data). In such situations operators may need to request suitable additional information or AFM provisions from the manufacturer, if temperatures or pressures exceed available AFM information or limitations. Data may be provided by the airplane manufacturer or other approved source (e.g., if the airplane manufacturer no longer exists or does not support the airplane type) for such unusual temperatures or surface pressures. In addition to acquiring the necessary data and revised limitations, these situations can also be an important additional consideration for go-around or missed approach assessment.

a. The operator should address appropriate flightcrew and dispatch procedures (if applicable) for identification of and appropriate setting and use of QNH, QNE, and QFE (if used). This should include emphasis on distinguishing appropriate use of metric versus non-metric units for altimeter settings as used by that operator (e.g., hectopascals (HPa), millibars (MB), or inches (in)). Emphasis should be placed on assuring use of proper settings for easily confused values for altimeter settings, particularly when abbreviated settings are used in ATS radiotelephony, ATIS messages, or checklists (e.g. "altimeter 993" being mistakenly confused for 29.93 inches instead of 0993 HPa when the appropriate units are metric).

b. The operator should address any appropriate flightcrew and dispatch procedures (if applicable) for unusually Low pressures if necessary for safe operations (e.g., unusable altitudes or flight levels of instrument procedures). The operator should address appropriate flightcrew and dispatch procedures (if applicable) for use of transition Level and transition altitude. If applicable, the operator should address appropriate flightcrew and dispatch procedures or limitations, as necessary, for use of VNAV in states using QFE for approach.

Table 6.2.10-1.

Below Standard Temperature Altimeter Error Adjustment Table

Note: Values are to be added to published altitudes.

Reported Temp (° C)	Height Above Reporting Facility in feet														Ter C f IS
	200	300	400	500	600	700	800	900	1000	1500	2000	3000	4000	5000	
10	10	10	10	10	20	20	20	20	20	30	40	60	80	90	-
0	20	20	30	30	40	40	50	50	60	90	120	170	230	280	-1
-10	20	30	40	50	60	70	80	90	100	150	200	290	390	490	-2
-20	30	50	60	70	90	100	120	130	140	210	280	420	570	710	-3
-30	40	60	80	100	120	130	150	170	190	280	380	570	760	950	-4
-40	50	80	100	120	150	170	190	220	240	360	480	720	970	1210	-5
-50	60	90	120	150	180	210	240	270	300	450	590	890	1190	1500	-6

Enter tables at next colder temperature and next higher height above facility.

6.2.11. Metric Altitudes. When used, the operator should address appropriate flightcrew and dispatch procedures for identification of and appropriate setting and use of altimeters, altitude alert systems, and altitude reference bugs for metric altitude. This should include emphasis on distinguishing appropriate use of metric versus non-metric units for altimeter settings, change over points, and callouts as used by that operator, and as applicable to the metric altitude routes and procedures used.

6.2.12. International "Approach Procedure Title" Requirements for or Limitations on NAVAID Use. The operator should address appropriate flightcrew and dispatch procedures (if applicable) for identification of and appropriate use of international approach procedures which may or may not have all necessary NAVAIDs listed in the "procedure title" (e.g., NDB ILS Rwy 16). For some of these procedures, NAVAIDs may be required which are not necessarily shown in the procedure title. For these instrument approach procedures the operator should ensure that appropriate airborne equipment is operating for dispatch (if applicable), and flightcrews should verify that appropriate navigation equipment is operating to safely conduct the approach and missed approach. Where substitutions are approved for U.S. operators (e.g., FMS based RNAV for NDB, VOR, or DME, or GPS for NDB) the operator should ensure flightcrews are familiar with substitutions allowable for that region, state or procedure.

6.2.13. "U.S. TERPS" or "ICAO PANS-OPS" Obstacle Clearance Procedural Protection Limitations. The operator should be aware that U.S. Standards for Terminal Instrument Procedures (TERPS) and/or "ICAO PANS-OPS" based instrument procedures principally address normal operations, including flight above DA(H) or MDA(H), and above any specified or assumed climb gradients. Non-normal operations may not ensure compliance with climb gradients assumed for

TERPS or PANS-OPS based standard procedures. Accordingly operators, flightcrews and dispatchers (if applicable) should consider any necessary airplane type specific or weight/altitude/temperature (WAT) specific procedures (e.g., similar to take-off procedures) that may be necessary to ensure safe obstacle clearance, for at least the following situations:

a. Engine failure prior to initiation of or during approach or missed approach.

b. Balked landing or go-around from below DA(H) or MDA(H) (e.g., as for inadvertent loss of visual reference).

c. Any special limitations that may be necessary for safe operations into section 121.445 designated airports. (e.g., Reno, NV [KRNO]).Any special precautions that may be needed if a flightcrew follows a published missed approach procedure or ATS instruction for a turn from below DA(H) or MDA(H), and before climbing to a safe altitude protected by the procedure or MVA.

d. The flight crew may consider use of an associated "IFR departure procedure" as an aid to ensure safe obstacle clearance, if initiating a go-around from below DA(H), MDA(H), or during a circling approach.

7. TRAINING AND CREW QUALIFICATION. This paragraph provides guidance for operators of airplanes, designing, developing, and implementing modernized flightcrew training and qualification**.** It must be clearly understood that an AC does not relieve an air carrier from meeting its requirements under a part 121 or part 135 operating certificate. Similarly, an AC does not diminish or relieve an air carrier from meeting its requirements in its approved training programs.

NOTE: For guidance to supplement this AC in respect to air carrier training and qualification programs, part 121 and part 135 certificate holders should refer to FAA Order 8400.10 and its appendices, as amended. The order has been revised to address the concepts presented in this AC, while respecting existing regulations in part 121, SFAR 58 (AQP), and part 135.

a. Training and crew qualification pertinent to Nonprecision, Category I, Category II, and lower than standard take-off minima should include effective ground and flight training. The training should ensure that flight crewmembers are well prepared for safe flight operations in low visibility instrument flight conditions. Further, that they are prepared for normal and non-normal conditions. Examples of non-normal conditions include engine malfunctions, system malfunctions, and other system anomalies. Although a training program for flight crewmembers is not required in 14 CFR part 125, certificate holders under that part are encouraged to conduct a training and qualification process for all flight crewmembers in accordance with this chapter.

b. An effective training and qualification process comprises initial qualification, recurrent qualification, upgrade qualification, differences qualification, recency of experience, and re-qualification. The operators program should provide appropriate training and qualification for each pilot-in-command (PIC), second-in-command (SIC) and any other pilot or flight crewmember expected to have knowledge of or perform duties related to Nonprecision, Category I, or Category II landing operations (e.g., Flight engineer, augmented flight crewmember).

c. Each PIC, and each other pilot or dispatcher, if applicable, having duties related to flight planning or use of Nonprecision, Category I, or Category II instrument procedures is expected to have comprehensive knowledge of areas described in paragraph 7.1. Each pilot expected to perform instrument procedures in normal or specified non-normal operations or perform duties associated with those procedures should have successfully demonstrated the necessary skills in accomplishing those designated maneuvers or procedures as shown in paragraphs 7.2 through 7.4. Demonstration of skill in performing instrument procedures typically is accomplished through simulator training, checking, or during line operating experience or evaluations. Pilots other than a PIC or SIC may only be expected to perform those relevant duties, procedures or maneuvers related to instrument procedures that are applicable to their own crew position or assigned duties (e.g., international relief officers).

7.1. General Knowledge (Ground) Training for All Weather Operations (AWO). Appropriate ground training should be conducted suitable for the "All Weather Operations," instrument procedures, airplane type(s) or variants, flightcrew positions, airborne systems, NAVAIDs, and ground systems used.

a. Topics should be addressed to include at least those listed in paragraphs 7.1.1 through 7.1.3, and be addressed or tailored to suit application to initial qualification, recurrent qualification, re-qualification, upgrade or differences qualification, as applicable.

b. Topics should be addressed for each PIC and any other pilots having assigned duties (e.g., SIC) as a PF or PNF during conduct of IAP's. When duties are specifically assigned to a PF or PNF (e.g., monitored approach, Category II), only those duties applicable to the assigned flightcrew position need be addressed for that flightcrew position. When instrument approach related duties are specifically assigned to other than the PIC or SIC, such as a flight engineer or relief pilot duties applicable to the assigned flightcrew position should be addressed. When flight crewmembers other than a PIC or SIC are not assigned duties associated with an IAP but are expected to be present on the flight deck during an instrument approach, it is recommended, but not required, that they also receive suitable academic training.

c. Acceptable methods to address ground training topics include classroom instruction, self guided slide/tape presentation, or computer-based instruction, or self-instruction using appropriate reference materials.

d. If the method of satisfying ground training requirements is exclusively through self guided learning or review from appropriate reference materials (e.g., flightcrew operating manual, Aeronautical Information Manual, and commercially available instrument procedure charts), the operator should use some clearly identified method (e.g., periodic written examination) to verify that each pilot has acquired or has retained the necessary knowledge.

7.1.1. Ground Systems and NAVAIDs for Nonprecision, Category I, or Category II.

a. Ground systems and NAVAIDs are considered to include characteristics of the airport, electronic navigation aids, lighting, marking and other systems (e.g., RVR) and any other relevant information necessary for safe Nonprecision, Category I, or Category II landing or low visibility take-off operations.

b. The training and qualification program should appropriately address the operational characteristics, capabilities and limitations of at least each of the following:

(1) NAVAIDs. The navigation systems or NAVAIDs to be used, such as the instrument landing system (ILS) with its associated critical area protection criteria, GPS Landing System (GLS), or Microwave Landing System (MLS) characteristics, as applicable, marker beacons, VOR, DME, NDB, DME, compass locators or other relevant systems should be addressed to the extent necessary for safe operations. If area navigation systems, or other non-ground based NAVAID systems (e.g., GNSS, LORAN) are used, any characteristics or constraints regarding that method of navigation or associated supporting elements (e.g., GBAS, WAAS), must be addressed.

(2) Visual Aids. Visual aids include approach lighting system, TDZ, centerline lighting, runway edge lighting, taxiway lighting, standby power for lighting and any other lighting systems that might be relevant to a Nonprecision, Category I, or Category II environment, such as pilot control of lighting aids, or coding of the center line lighting for distance remaining, and lighting for displaced thresholds, land and hold short lighting, or other relevant configurations should be addressed.

(3) Runways and Taxiways. The runway and taxi way characteristics concerning width, safety areas, obstacle free zones, markings, hold lines, signs, holding spots, runway slope, suitability of TCH, unusual friction, grooving, or PFC characteristics, critical area protection areas, or taxiway position markings, runway distance remaining markings and runway distance remaining signs should be addressed.

(4) Meteorological Information. METAR's, TAF's, visibility reporting, Transmissometers systems, including RVR locations, readout increments, sensitivity to lighting levels set for the runway edge lights, variation in the significance of reported values during international operations, controlling and advisory status of readouts, and requirements when transmissometers become inoperative. Appropriate use of Temperatures in C or F, conversion of temperatures between C and F. Appropriate use of pressure information including altimeter settings in units of HPa or inches, QNE, QNH, QFE (if applicable). Appropriate use of Transition Level and Transition Altitude. Appropriate interpretation and use of reported wind and gust information, in true or magnetic direction, as applicable to the source and circumstance.

(5) NOTAM's and other Aeronautical Information. Facility status, proper interpretation of outage reports for lighting components, standby power, or other factors and proper application of NOTAM's regarding the initiation of Nonprecision, Category I, or Category II approaches or initiation of a low visibility take-off.

(6) Flight Planning and Flight Procedures Related to Inoperative or Unsuitable NAVAIDs. When NAVAID position updating is used in support of area navigation position determination (e.g., VOR, VOR-DME, DME-DME, GNSS updating), operators and flightcrews should be aware of when and how to disable use of an unsuitable NAVAID or updating method within the airborne navigation system. This is especially true for NAVAID failure conditions that are probable to cause a significant

map (position) shift (e.g., movement of a NAVAID to a new location without corresponding update of the NAVAID position in a database, significant numbers of space vehicle outages, or areas of interference).

7.1.2. The Airborne System. The training and qualification program should address the characteristics, capabilities, and limitations of each appropriate airborne system element applicable to Nonprecision, Category I, or Category II landing including the following:

a. Flight guidance system. The flight guidance system, including appropriate modes to be used for different circumstances or procedures (e.g., APPROACH, Heading (HDG), V/S, LNAV/VNAV), and any associated landing system or landing and roll out system, or go-around capability, if applicable (e.g., autopilot, autoland).

b. Flight director system. The flight director system, including appropriate modes to be used for different circumstances or procedures (e.g., APPROACH, HDG, V/S, LNAV/VNAV), and including any associated landing or landing and roll out capability, or go-around capability, if applicable (e.g., HGS).

c. Automatic throttle. The automatic throttle control system, if applicable. Mixed mode autoflight/autothrottle operation should be addressed (e.g., manual flight, but with autothrottles on, or vice versa), if pertinent to the airplane type.

d. Displays. Situation information displays, as applicable, including any applicable limits for acceptable approach performance to continue an approach, flare, rollout, or go-around (e.g., typically 1/2 dot or less lateral or vertical displacement below 500 ft. HAT down to DA(H).

e. Status, Alerting, and Warning Displays. Other associated instrumentation and displays, as applicable, including any monitoring displays, status displays, mode annunciation displays, failure or warning annunciations and associated system status displays that may be relevant.

f. Means for determining DA(H) or MDA(H). The means for determining DA(H) or MDA as follows:

(1) DA(H) as applicable to the particular Category I ILS, GLS, or MLS procedure (e.g., as an applicable DA, or Marker Beacon substitute for a DA when authorized);

(2) DA(H) as applicable to the particular RNAV procedure with VNAV (e.g., as an applicable DA);

(3) MDA as applicable to the particular Nonprecision procedure other than ILS, GLS, or MLS (e.g., as an applicable MDA, and any associated missed approach point); and

(4) DA(H) as applicable to the particular Category II ILS, GLS, or MLS procedure (e.g., as an applicable DH, or Marker Beacon substitute for a DH, when authorized).

g. Other Flight Deck Systems. Other flight deck systems operations or use, as may be related to low visibility operations (e.g., autobrakes, autospoilers), and any associated limitations, characteristics, or constraints (e.g., touchdown pitchup or pitchdown tendency of certain autospoiler or autobrake settings or non-normal conditions, time delays, auto-deactivation features with go-around).

h. Other airplane characteristics. Any system or airplane characteristics that may be relevant to Nonprecision, Category I, or Category II operations, such as cockpit visibility cutoff angles and the effect on cockpit visibility of proper eye height, seat position or instrument lighting intensities related to transition through areas of varying brightness visual conditions change. Flightcrews should be aware of the effects on flight deck visibility related to use of different flap settings, approach speeds. Minimum usable TCH and minimum or maximum final approach descent gradients should be addressed, if applicable.

i. Lighting. Proper use of various landing, taxi, turnoff, wing, logo, or strobe lights for approach visibility, taxi, or collision avoidance conspicuity.

j. Rain Removal and De-fog. Proper procedures for use of rain removal/defog (e.g., windshield wipers). If windshield defog, anti-ice, or de-icing systems affect forward visibility, flightcrews should be aware of those effects and be familiar with proper settings for use of that equipment related to low visibility landing.

k. Course and Frequency Selection. For automatic or manual systems which require flightcrew input for parameters such as inbound course or automatic or manually tuned navigation frequencies, the flightcrew should be aware of the importance and significance of any incorrect selections or settings, if not obvious, to ensure appropriate system performance.

l. Environmental Limits. Description of the limits to which acceptable system performance has been demonstrated for headwind, tailwind, crosswind, and wind shear as applicable, and recognition of unacceptable performance in the case of adverse weather (e.g., windshear, turbulence).

m. Non-normal or Failure Conditions. Recognition and response to pertinent non-normal or failure conditions, and related non-normal procedure and checklist use for flight guidance, instrument, and supporting systems (electrical, hydraulic, and flight control systems).

n. Go-Around. Proper airborne system use for go-around, including consideration of height loss during transition to a go-around, performance assurance for obstacle clearance, management of any necessary mode changes, and assurance of appropriate vertical and lateral flight path tracking.

o. As applicable, the operator may consult with the FAA to ensure that information presented by the operator about any training or qualification items or issues referenced above, or any additional issues pertinent to the type airplane or system used, are consistent with the pertinent FAA Flight Standardization Board (FSB) Report for the applicable airplane type.

7.1.3. Flight Procedures, Operations Specifications, and Other Information.

a. Regulations and OpSpecs. Pilots, and dispatchers if applicable, should be familiar with FAA regulations pertinent to their operation (e.g., sections 91.175, 121.651, 125.381 and 135.225) and OpSpecs applicable to Nonprecision, Category I, or Category II landing, or lower than standard take-off minima, as applicable.

b. Flightcrew Duties. Pilots should be familiar with appropriate crew duties, monitoring assignments, transfer of control during normal operations using a monitored approach (Order 8400.10, paragraph 549) appropriate automatic or flightcrew initiated call-outs to be used, proper use of standard IAP's, special IAP's, applicable minima for normal configurations or for alternate or failure configurations and reversion to higher minima in the event of failures.

c. Visibility and RVR. Pilots, and dispatchers if applicable, should be familiar with proper application of meteorological visibility, METAR's, TAF's, runway visual range (RVR), RVV (if applicable), including their respective use and limitations, the determination of controlling RVR and advisory RVR, required transmissometers, appropriate light settings for correct RVR readouts and proper determination of RVR values reported at foreign facilities. Pilots should be familiar with any authorized methods for pilot assessment and reporting of visibility at foreign facilities.

d. Procedures and Charts. Pilots, and dispatchers if applicable, should be familiar with the proper use of instrument procedures and charts including application of DA(H) and MDA, and when to use DA, DH, or an equivalent (e.g., OCA (H)), or MDA as applicable, including proper use and setting of barometric or radar altimeter bugs, use of the inner marker where authorized or required due to irregular underlying terrain and appropriate altimeter setting procedures for the barometric altimeter consistent with the operators practice of using either QNH or QFE, and if applicable. Pilots should be aware of when to make suitable cold weather temperature corrections for altimeter systems and procedures, if necessary. (See 6.2.10)

e. Visual references. Pilots should be familiar with the availability and limitations of visual references encountered, both on approach before and after DA(H), if a DA or DH is applicable. Pilots should be familiar with the expected visual references likely to be encountered. Pilots should be familiar with procedures for an unexpected deterioration of conditions to less than the minimum visibility specified for the procedure during an approach, flare or rollout including the proper response to a loss of visual reference or a reduction of visual reference below the specified values when using a DA(H) or MDA and prior to the time that the airplane touches down. The operator should provide some means of demonstrating the expected visual references where the weather is at acceptable minimum conditions and the expected sequence of visual cues during an approach in which the visibility is at or above the specified landing minimums. This may be done using simulation, video presentation of simulated landings or actual landings, slides showing expected visual references, computer based reproductions of expected visual references or other means acceptable to the FAA.

f. Visual Transition. Procedures should be addressed for transitioning from non-visual to visual flight for both the PIC, SIC, as well as the pilot flying and pilot not flying during the approach. For systems that include electronic monitoring displays, as described in item (5) above, procedures for transitioning from those monitoring displays to external visual references should be addressed.

g. Unacceptable Displacements. Pilots should be familiar with the recognition of the limits of acceptable airplane position and flight path tracking during approach, flare and if applicable rollout. This should be addressed using appropriate displays or annunciations for the airplane type and training contained in Order 8400.10 paragraph 581.

h. Environmental Effects. Environmental effects should be addressed. Environmental effects include appropriate constraints for head winds, tail winds, cross winds, and the effect of vertical and horizontal wind shear on automatic systems, flight directors, or other system (e.g., HGS) performance. For systems such as head-up displays which have a limited field of view or synthetic reference systems (e.g., Enhanced Vision System (EVS) or Synthetic Vision System (SVS)) pilots should be familiar with the display limitations of these systems and expected crew actions in the event that the airplane reaches or exceeds a display limit capability. Extreme temperature or pressure effects should be considered, if necessary. (See 6.2.10)

i. Operator Polices. Pilots, and dispatchers if applicable, should be familiar with the operators policies and procedures concerning any constraints applicable to Nonprecision, Category I, or Category II landings, or low visibility take-off including constraints for operations on contaminated or cluttered runways. Procedures to be used when obscuring of appropriate lighting or markings occurs, and limits should be noted for operations on slippery or icy runways regarding both directional control and stopping performance. Pilots and dispatchers if applicable, should be familiar with appropriate constraints related to use of braking friction reports. Pilots and dispatchers if applicable, should be familiar with the method of providing braking friction reports applicable to each airport having instrument landing operations.

j. Response to Airplane or System Failures. Pilots should be familiar with the recognition and proper reaction to significant airplane system failures experienced prior to and after reaching the final approach fix and experienced prior to and after reaching DA(H), as applicable. Expected flightcrew response to failures prior to touchdown should be addressed, particularly for Category II operations.

k. Ground or Navigation System Faults. Pilots are expected to appropriately recognize and react to ground or navigation system faults, failures or abnormalities at any point during the approach, before and after passing DA(H) and in the event an abnormality or failure which occurs after touchdown. Pilots should be familiar with appropriate go-around techniques, systems to be used either automatically or manually, consequences of failures on go-around systems which may be used, the expected height loss during a manual or automatic go around considering various initiation altitudes, and appropriate consideration for obstacle clearance in the event that a missed approach must be initiated below DA(H).

l. Navigation Anomalies or Discrepancies. Pilots, and dispatchers if applicable, should be familiar with the need to report navigation system anomalies or discrepancies, or failures of approach lights, runway lights, touchdown zone lights, center line lights or any other discrepancies which could be pertinent to subsequent Nonprecision, Category I, or Category II operations.

m. International Procedures. Pilots, and dispatchers if applicable, should be familiar with any applicable international procedures including application of OCA, OCH, the applicable State AIP, or regional supplements (if not otherwise addressed by the operator in the FCOM or equivalent and excerpts), pertinent excerpts from ICAO references (e.g., Manual for All Weather Operations - ICAO DOC 9365AN/910). This includes regulatory requirements and responsibilities at foreign airports (e.g., approach ban and "look see" provisions).

n. Performance and Obstacle Clearance. Pilots and dispatchers if applicable, should be familiar with any applicable airplane performance or weight limit information to ensure safe obstacle clearance for "all engine" or "engine inoperative" missed approach, or rejected landing. Applicable performance information should consider applicable flap settings to be used, go-around procedures, acceleration segments if applicable, transition at any time following an engine failure between the specified "all-engine lateral flight path" (or radar vectors) and any specified "engine-inoperative lateral flight path," using acceptable flap retraction and cleanup height procedures.

o. Flight Plans and Equipment Classification. Pilots, and dispatchers if applicable, should be familiar with use of appropriate flight plan equipment classifications [e.g., Required System Performance (RSP)] affecting eligibility for various take-off or landing procedures (e.g., flight plan /F, /E designations), and proper alternate airport identification and use, including any take-off, en route ETOPS, or destination alternates, as applicable.

p. EVS, SVS, or ILM. When a synthetic reference system such as a "synthetic vision system" (SVS) or "enhanced vision system" (EVS) or "Independent Landing Monitor" (ILM) system is used, pilots should be familiar with the interpretation of the displays to ensure proper identification of the runway and proper positioning of the airplane relative to continuation of the approach to a landing. Pilots should be briefed on the limitations of these systems for use in various weather conditions and specific information may need to be provided on a site-specific basis to ensure that misidentification of taxiways or other adjacent runways does not occur when using such systems.

7.2. Maneuver or Procedure (Flight) Training for All Weather Operations (AWO).

a. Airplane or Flight Simulator Use. Maneuver/Procedure (Flight) training and evaluation should be provided, and should use appropriate simulation capability (e.g., Level C or D). If simulation capability is not available, training or evaluation may be accomplished partially with training devices, or partially or completely in an airplane. However, when training or evaluation is done using training devices, or with simulators with limited capability (e.g., not Level C or D), or with an airplane, additional factors or techniques (e.g., use of Computer Based Training (CBT)) may need to be considered by the operator to ensure effective training.

b. Addressing Applicable Regulations. Maneuver or procedure training should generally address applicable part 121 Appendix E or F provisions, an approved AQP program as applicable, approach and landing events specified in part 61, relevant FAA Order 8400.10, airman certification take-off and landing provisions, FAA Order 8700.1 for part 125 competency or instrument checks, or FAA ATPC Practical Test Standards (PTS) as applicable, or as described below.

c. Types Of Procedures And Conditions To Be Addressed. Maneuvers and procedures trained should be keyed to the types of instrument procedures **used** by the operator, the environment in which they are flown, and any special considerations that may apply to their safe application. Operating policies, procedures, and documentation representative of that applicable to the particular operator should be used. Maneuver and Procedure Training and any necessary evaluation should ensure that instrument procedures can be safely flown considering at least the following factors, as applicable to the specific operator:

(1) Types of instrument procedures used (standard and special, if applicable),

(2) That Operator's manuals, charts, and checklists,

(3) Airplane type(s) and variants flown,

(4) Flight guidance system(s) used,

(5) NAVAID(s) and visual aids used,

(6) Flightcrew procedures used (e.g., PF/PNF duties, monitored approach, callouts),

(7) Airport characteristics typically experienced (e.g., visual aids, transition level, air traffic procedures, met procedures, signs and markings, unusual airport features (elevations, slope) as applicable),

(8) Runway characteristics typically experienced (e.g., representative field lengths, grooving, marking),

(9) Nearby critical terrain or obstruction environment, if applicable,

(10) Relevant environmental conditions (e.g., wind, turbulence, shear, visibility and ceiling conditions, slippery runways, rain or snow effects on visibility),

(11) Lowest Nonprecision, Category I, or Category II straight-in, or circling minima as applicable, and

(12) Other relevant AWO characteristics (e.g., special instrument procedures).

d. Use of Part 121 Appendix H Level C or D Simulators.

(1) When simulation (e.g., part 121 appendix H level C or D) is the primary method used for flight training or evaluation for take-off, approach and landing procedures, appropriate normal, non-normal, and environmental conditions (relevant wind, turbulence, visibility and ceiling conditions) should be simulated. In this instance, training and evaluation need only be

conducted using applicable landing minima and relevant and representative procedures and conditions (e.g., a representative mix of day, night, dusk, variable/patchy conditions, representative temperatures, landing runway altitudes, precipitation conditions, turbulence, and icing conditions). Multiple requirements for maneuvers may be combined at the discretion of the POI/APM/CMO/CMU, subject to the constraints below (e.g., to preclude the need to repeat various Nonprecision, Category I/II/III, approach scenarios for normal approaches, approaches with an engine(s) out, missed approach, landing, rejected landing, and various go-around events). The training benefit of realistic simulation is acknowledged, and credit for use of a representative sample of conditions to be flown, directly using pertinent minima, is considered to be acceptable. Accordingly, when level C or D simulation is used, only a sample of procedural types, environmental conditions, successful flightcrew performance, and other factors listed in c. above need be assessed. However, when such credit for combining events is permitted, the operator and CMO/CMU/POI/APM should nonetheless ensure that the program used leads to flightcrews reliably performing the necessary low visibility procedures under both normal and anticipated non-normal conditions in line service. Numbers and types of training or demonstration instrument approach procedure events for various types of training or checking or qualification programs are suggested in paragraphs 7.2. through 7.7 below.

(2) In instances where Level C or D simulation is typically used IAW this provision, but the level of simulation capability is temporarily degraded to Level A or B, the operator with CMO concurrence may nonetheless apply provisions of this paragraph on a temporarily basis, until the simulation capability can be returned to level C or D status.

e. Use of Simulators OTHER THAN Part 121 Appendix H Level C or D, use of Training Devices, or use of an Airplane. When part 121.appendix H level C or D simulation (or equivalent) is not used for AWO Qualification (e.g., when an airplane is used, or a training device(s) level 2 through 7, or visual simulator, or non-visual simulator, or Level A or B simulator, or a simulator qualified for Level C or D but used as an FBS is used) certain restrictions and additional provisions may apply to training or qualification, as follows:

(1) The POI or CMO/CMU may require that during training or evaluations the flightcrew demonstrate satisfactory lateral and vertical flight path tracking performance, to applicable tolerances, and to ensure flight path stability after passing DA(H). This is to address the possible lack of visual reference or external environmental disturbances that may exist in real operations but that may be minimal or absent during training or testing in limited capability simulators or simulation devices (e.g., due to lack of visual reference, turbulence or other disturbances being faithfully represented).

(2) The POI or CMO/CMU may require that additional procedures or combinations of procedures be demonstrated, or that limitations apply to operations shown in this AC in terms of operational approval for combining maneuvers or types of procedures trained, maneuvers demonstrated, or other events evaluated (e.g., for combinations of various Nonprecision, Category I, II, III procedures for ILS, VOR, VOR/DME, NDB, Back Course Localizer, engine inoperative missed approach or landing procedures).

(3) The POI or CMO/CMU may require additional training or checking event items beyond those identified in this AC below, or those addressed only generically in part 121 appendix E or F, or in part 61 as applicable (e.g., providing for HUD or autoland qualification where part 121 or 91 only make general reference to items like other special characteristics as necessary),

(4) When using an airplane for training or testing, the POI or CMO/CMU may require that provision be made for use of a view limiting device for any necessary competency demonstrations. This is particularly applicable to any evaluation of a pilot that has not previously qualified to fly a similar class of airplane (e.g., large turbojet airplanes), or for a pilot that does not have significant instrument experience beyond that necessary to satisfy minimums for issuance of an FAA commercial pilot’s license with instrument rating.

f. Flight Training Maneuvers for Nonprecision, Category I, or II Landings. Maneuvers may be addressed individually as a respective Nonprecision, Category I, or Category II maneuver, or an appropriate sample of Nonprecision, Category I, and Category II maneuvers may be trained and evaluated, if flightcrews are to be both Category I and II qualified. When flightcrews are authorized to use minima for Category III, as well as Category II, samples of maneuvers selected to be performed for training and evaluation may be from appropriate combinations of Category I, II, and III procedures. When found acceptable to the CHDO/POI, each maneuver need not be repeated for each Category of landing weather minima to be authorized. Flight training for Nonprecision, Category I, or Category II landing should address at least the following maneuvers:

(1) Normal landings. Normal landings at the lowest applicable Nonprecision, Category I, or Category II minima, using representative autoflight configurations or combinations of configurations authorized for use (e.g., flight director, autopilot, autothrottles);

(2) Missed approach. A missed approach from the lowest applicable DA(H) and MDA, (may be combined with other maneuvers);

(3) Balked landing. A balked landing or missed approach from a low altitude that could result in a touchdown during go-around (balked landing or rejected landing - may be combined with other maneuvers);

(4) System or NAVAID Failures. Appropriate airplane and ground system NAVAID failures (may be combined with other maneuvers);

(5) Engine Failures. Engine failure prior to or during approach (if specific flight characteristics of the airplane or operational authorizations require this maneuver);

(6) Low Visibility Rollout. Manual roll out with low visibility at applicable minima (may be combined);

(7) Realistic Environmental Conditions. Landings (in simulation) with environmental conditions at a representative sample of limiting values authorized for applicable Nonprecision, Category I, or II minima for that operator (e.g., regarding wind magnitude, headwind and crosswind components, turbulence, and runway surface friction characteristics (wet, snow, slippery) may be combined); and

(8) Non-normal configuration approaches and landings. Representative non-normal configuration approaches and landings in instrument conditions should be demonstrated. For these approaches, the simulated weather minima may be above, or well above, the lowest Nonprecision, Category I, or Category II minima authorized. Minima should be at levels that might typically be experienced in line operations, for a landing with the non-normal condition used. During these approaches, representative autoflight, instrument, and airplane system configurations or combinations of configurations should be demonstrated (e.g., flight director, autopilot, autothrottles, situation information, inoperative electrical or hydraulic components).

(9) Basic Airmanship. In accomplishing items (1) through (8) above, each pilot should demonstrate competence, or be judged to have the necessary competence in basic airmanship to adequately address:

(a) Manual Control. Manual control, or reversion to manual control of the airplane, if necessary, (for FBW airplanes, normal law or configuration is acceptable);

(b) Automation. Proper use of automation;

(c) Situation Awareness. Appropriate planning and situation awareness, including terrain awareness;

(d) Detection and coping with adverse environmental factors. Ability to detect and cope with adverse environmental conditions (e.g., applicable crosswinds, turbulence, windshear, convective weather, or adverse airport conditions (e.g., slippery runways));

(e) Detection and coping with adverse NAVAID factors. Ability to detect and cope with adverse ground system, space system, or NAVAID failures or anomalies); and

(f) flightcrew coordination and Cockpit Resource Management (CRM). Proper flightcrew coordination, and flightcrew resource management.

g. Flight Training Maneuvers for Take-offs. For low visibility take-off (less than 2400 RVR), the following maneuvers and procedures should be addressed (may be combined):

(1) Normal take-off;

(2) Rejected take-off from a point prior to V_1 (including an engine failure);

(3) Continued take-off following failures including engine failure, and any critical failures for the airplane type which could lead to lateral asymmetry during the take-off; or

(4) Limiting conditions. The conditions under which these normal and rejected take-offs should be demonstrated include appropriate limiting cross winds, winds, gusts, and runway surface friction levels authorized. A demonstration should be done at weights or on runways that represent a critical field length.

h. Demonstration Of Appropriate PF or PNF Duties By Each Pilot. During each of the specified maneuvers or procedures, flight crewmembers are expected to perform their respective assignments or duties (e.g., Captain, First Officer, PIC, SIC, Pilot-Flying (PF), Pilot-Not-Flying (PNF)), as applicable. However, PIC's and SIC's should typically be able to perform either PF or PNF duties, unless otherwise limited by the operator's policies or airplane characteristics (e.g., if F/Os are precluded by operator policy or system installation (HUD) from serving as PF during certain adverse weather take-offs or landings). In situations where flight crewmembers are being qualified other than as part of the complete flightcrew (e.g., when two pilots in command are being qualified) or when a pilot other than the PIC is also to be authorized to serve as the PF for low visibility operations, each flight crewmember should individually demonstrate the required maneuvers or procedures, or an acceptable sample of procedures. Relevant procedures are those involving manual control of the airplane, rather than procedures such as autoland, which may not involve significant differences in PF or PNF skills.

7.2.1. Initial Qualification. Prior to maneuver or flight training, Initial General Knowledge (Ground) Training for "All Weather Operations (AWO)" should be addressed. Coverage of those subjects specified in 7.1 should typically be completed for each pilot having assigned AWO responsibilities.

a. Maneuver or Procedure (Flight) Training addressing suitable for that operator's Initial Qualification for "All Weather Operations (AWO)" should be conducted. While the number of procedure types covered, number of simulator periods, number of training flights, if any, or other factors may vary, coverage should at least address the expected initial assignment of the flight crewmember receiving the initial training. AWO training may be combined with the initial airplane type qualification training program or it may be done separately as an AWO qualification. Regardless, the operator is expected to provide sufficient initial training to assess knowledge and skills of each new flight crewmember, address any individual area of weakness, ensure that each flight crewmember can perform to applicable AQP, PTS, or other relevant standards, and ensure that each flight crewmember can competently perform the maneuvers or procedures specified in 7.2 above.

b. If weaknesses are identified, the operator is expected to provide sufficient remedial training to ensure that any new flight crewmember can perform to applicable FAA Commercial Pilot, Instrument, Multiengine, or ATPC standards, for the applicable airplane type or variant, and can acceptably use that operator's policies, manuals, and procedures, before releasing that crewmember for flight operations.

c. When Nonprecision, Category I, or II minima are based on manual operations using systems like head-up displays or flight directors, a number of repetitions of the maneuvers specified in 7.2 above may be necessary to ensure that each of the required maneuvers can be properly and reliably performed.

d. Operators should also ensure that flight crewmembers receiving initial training demonstrate basic airmanship related to AWO (e.g., crosswind take-off and landing skills, ability to fly using situation information, ability to assess and safely cope with poor runway friction, make adverse weather avoidance judgments), or are provided relevant remedial training.

e. Guidance for acceptable training related to a particular airplane type can be found in FAA FSB reports for specific airplane types. Operators should adhere to FSB guidelines when published, unless otherwise authorized by the FAA. Sufficient assessment should take place to ensure that the operator has determined that above objectives have been met for each flight crewmember, and that the resulting evaluation or assessment can be documented.

7.2.2. Recurrent Qualification.

a. Recurrent General Knowledge (Ground) training for All Weather Operations (AWO). Recurrent General Knowledge (Ground) Training for AWO should provide any remedial review of topics specified in 7.1 to ensure continued familiarity with those topics. Emphasis should be place on any program modifications, changes to airplane equipment or procedures, review of any occurrences or incidents that may be pertinent. Also, emphasis may be placed on re-familiarization with topics such as mode annunciations for failure conditions or other information which the pilots may not routinely see during normal line operations. Topics to be addressed for each pilot in command (PIC), second in command (SIC), or other flight crewmember, or dispatcher if applicable, are those topics necessary for the performance of the assigned duties for each respective flight crewmember or dispatcher in the current assignment.

b. Recurrent Maneuver or Procedure (Flight) Training for All Weather Operations (AWO). Recurrent Maneuver or Procedure

(Flight) Training for Nonprecision, Category I, or II landings and low visibility take-offs, as applicable, should be provided to ensure competency in each of the maneuvers or procedures listed in 7.2 above.

(1) Recurrent Maneuver or Procedure (Flight) Training should be conducted using an approved simulator with an appropriate visual system. In the event that simulation is not available, recurrent flight training may be accomplished in the airplane, as approved by the CHDO/POI considering factors identified in Paragraphs 7.2 d and e.

(2) Recurrent flight training should include at least a sample of the applicable Nonprecision, Category I, or Category II procedures to be used by the operator. The assessment should emphasis any critical procedures used by that operator which have not otherwise been routinely flown, or may not have been recently flown by a flight crewmember, but which may otherwise need to be reviewed to ensure they can be accomplished correctly. Emphasis may be placed on any critical non-normal procedures (e.g., engine inoperative, system failure cases), and any special emphasis procedures or items found to require attention due to in-service feedback by the operator (e.g., excessively high descent rates near the surface, proper VNAV use). At least some procedures should be sampled at or near limiting adverse weather conditions (e.g., at minimum RVR or limiting wind components or with windshear, or to runways with minimum operationally used field lengths, or at critical terrain airports or at airports having operator unique special airport procedures). Repetition of maneuvers frequently accomplished successfully in line operations (e.g., normal ILS, normal autoland) may be de-emphasized by limited sampling, and limited assessments of those conditions and procedures.

(3) Recurrent flight training maneuvers may be accomplished individually or may be integrated with other maneuvers required during proficiency training or during proficiency checking. If minima are authorized using several methods of flight guidance and control such as FMS, autopilot, flight director, or head-up display, then the training program should assure an appropriate level of proficiency using each authorized mode or system. Where Nonprecision, Category I, or II minima are based on manual control using flight guidance such as provided by a head up flight guidance system, appropriate emphasis should be placed on failure conditions which a pilot does not normally experience in line operations.

(4) When take-off minima below RVR2400 are approved, recurrent flight training must include at least one rejected take-off at the lowest approved take-off minimum used, with an engine failure near but prior to V_1.

(5) Numbers of maneuvers or procedures to be performed during recurrent training or checking should be sufficient to ensure appropriate flight crewmember performance, but not less than the following:

(a) An engine inoperative approach to a landing and a go around.

(b) Appropriate airplane or ground system NAVAID failures.

(c) Approaches and landing(s) with environmental conditions at a representative sample of limiting values authorized for applicable Nonprecision, Category I, or II minima for that operator (e.g., wind components, turbulence, windshear or limiting runways, or adverse runway surface friction).

(d) Any special emphasis procedures or items identified by the operator or CHDO/POI.

(e) A low visibility take-off with critical performance or a suitable failure condition.

7.2.3. Requalification.

a. Operational approval for previous Nonprecision, Category I, or II qualification in a different airplane type or variant, or previous qualification in the same type or variant at an earlier time may be considered in determining the nature of the training and the maneuvers to be completed or the repetition of maneuvers for re-qualification for Nonprecision, Category I, or II operations. Any re-qualification program should ensure that the pilots have the necessary knowledge of the topics specified in paragraph 7.1 and are able to perform their assigned duties for Nonprecision, Category I, or II or low visibility take-off considering the maneuvers or procedures identified in Paragraph 7.2.

b. For programs which were approved under previous Nonprecision, Category I, or II qualification in a different type airplane, the transition program should ensure that any subtle differences between airplane types which could lead to pilot misunderstanding of appropriate characteristics or procedures in the new type must be suitably addressed.

7.2.4. Upgrade Qualification.

a. If operational approval for previous Nonprecision, Category I, or II qualification in a different type of airplane is being considered, or in a different crew position in the same type or variant at an earlier time, then requalification should ensure that the pilot has the necessary knowledge of the topics specified in paragraph 7.1. Pilots must also be able to perform the new or additional assigned duties for the new crew position for Nonprecision, Category I, or Category II, or low visibility take-off operations, considering the maneuvers or procedures identified in paragraph 7.2, in order to ensure that training in the new type is effectively addressed.

b. Operational approval may also be permitted, as determined appropriate by the CMO, for prior pilot experience with a similar flight deck and flight guidance system (e.g., A330 and A340; B757 and B767). (Also see FAA AC120-53).

7.2.5. Differences Qualification - Addressing Cockpit or Airplane System Differences. For Nonprecision, Category I, and II programs using airplanes which have several variants, training programs should ensure that pilots are aware of any differences that exist and appropriately understand the consequences of those differences. Guidelines for addressing differences can be found in AC 120-53 and FSB reports applicable to a particular type.

7.2.6. Recency of Experience. Recency of experience requirements specified by section 121.439 or IAW AC 120-53 normally provide an assurance of the necessary level of experience for Nonprecision, Category I, or II landing or low visibility take-off operations. In the event that special circumstances exist where flight crewmembers may not have exposure to particular aspects of the flight guidance system used for long periods of time beyond that permitted by section 121.439 or AC 120-53, then the operator should ensure that the necessary recency of experience is addressed prior to pilots conducting Nonprecision, Category I, or II landings, or low visibility take-off operations below RVR 2400.

a. For RNAV approaches or automatic landing systems, pilots should specifically be exposed to use of these systems and procedures during training or checking if the flightcrew has not otherwise conducted frequent relevant similar line operations with those systems since the previous training cycle or event.

b. For manual flight guidance landing or take-off systems (e.g., HUD) a pilot flying should typically be afforded an opportunity to use such systems or procedures in the airplane or in simulation once each 90 days. If the pilot has not otherwise had an opportunity to conduct line approaches or landings using the manual flight guidance system within the previous 90 days, a simulator refresher, recurrent training or checking event, line operational use in weather conditions better than basic VFR, flight with a check airman, or other similar method acceptable to the POI may be used to re-establish recency of experience with that system.

7.3. Checking or Evaluations.

7.3.1. Checking For Nonprecision and Category I Qualification. Testing, checking, or evaluation for Nonprecision and Category I is basic to qualification for IFR operations, and should be accomplished in conjunction with basic aircraft type or variant qualification for each crew position. Testing or evaluation, if necessary and as necessary, should be keyed to assuring that each pilot has the necessary knowledge and skill appropriate to the type of qualification being completed (e.g., Initial, transition, upgrade, differences, or re-qualification programs) IAW applicable regulations (e.g., SFAR 58 Approved AQP program, part 121 appendix F, part 61, and applicable FAA Airline Transport Pilot Certificate (ATPC) Type Rating Practical Test Standards for airline transport pilot and airplane type rating for airplanes and the FAA approved training program). (Also see initial, transition, upgrade, or differences paragraphs above.)

7.3.2. Checking For Category II Qualification. Specific testing or evaluation should be completed for Category II qualification. Flight crewmembers should demonstrate proper use of Category II related airplane systems and correct procedures including any provisions otherwise specified by an applicable FSB report. If not otherwise addressed by Nonprecision, Category I, or Category III qualification, pilots should demonstrate proficiency in performing duties related to conduct of Category II approaches including at least the following conditions individually, or in any combination:

a. A normal approach to a landing and to a go-around at or near Category II minima;

b. Approaches with related airplane system, navigation system, or flight guidance failures;

c. An engine-inoperative approach (if authorized for engine-inoperative Category II capability);

d. For initial qualification which includes use of an automatic landing system, at least one automatic landing, and if applicable, one automatic go-around from a low approach (at or after DA(H) but before touchdown). The approach or go-around may be conducted in either normal or non-normal conditions, as determined appropriate by the operator and CHDO;

e. For continuing qualification which includes use of an automatic landing system, at least one automatic landing or low altitude automatic go-around (if applicable), with a relevant non-normal condition;

f. For manual flight guidance and control systems (e.g., HUD) one landing at the lowest applicable minima and one go-around from low altitude below DA(H), and at least one response to a failure condition during the approach or missed approach; and

g. Recognition and proper response to other representative non-normal conditions or adverse weather situations (e.g., Outage NOTAM, NAVAID failure, variable or below minima weather, ILS critical area protection anomaly).

7.3.3. Checking For Low Visibility Take-off Qualification.

a. For new low visibility take-off authorizations, and unless otherwise qualified for low visibility take-off IAW FAA AC 120-28D, before using any take-off minima below RVR1200, pilots should have successfully demonstrated in simulation at least one take-off at the lowest applicable minima with an engine failure at or after V_1, and one rejected take-off with an engine failure or other appropriate failure prior to V_1.

b. If an acceptable simulator is not available, the demonstration may be conducted in the type of airplane to be authorized for use of take-off minima below RVR1200. Representative failure speeds and conditions may be used that do not risk or adversely affect the airplane or its systems (e.g., tires and brake energy). Use of a view limiting device for the pilot being evaluated is not necessary.

7.4. Experience with Line Landings. For Category II, unless otherwise specified by an applicable FSB report for the airplane type, when a qualification program has been completed using a simulator program other than Level C or D, at least the following experience should be required before initiating Category II operations:

a. For automatic systems at least one line landing using the auto flight system approved for Category II minima should be accomplished in weather conditions at or better than Category II.

b. For manual systems such as head-up flight guidance system for Category II, the PIC must have completed at least ten line landings using the approved flight guidance system and procedures, in the configuration specified for Category II, at suitable runways and using suitable landing NAVAIDs.

7.5. Multiple Airplane Type or Variant Qualification. In the event that flight crewmembers are multiply-qualified as either captain or first officer, or for performing the duties of the PIC or SIC (e.g., International relief officers), or for flight crewmembers dual qualified between several airplane types or variants, appropriate training and qualification must be completed to ensure that each flight crewmember can perform the assigned duties for each crew position and each airplane type or variant.

7.6. Training Regarding Use of Foreign Airports for Nonprecision, Category I, or Category II Operations. Operators authorized to conduct Nonprecision, Category I, or Category II operations or low visibility take-offs below RVR1200 at foreign airports, which require procedures or limitations different than those applicable within the U.S., should ensure that flight crewmembers, and dispatchers if applicable, are familiar with any meteorological reporting, airport, visual aid, NAVAID, or ATS clearance or procedure differences appropriate to operations at those foreign airports.

7.7. Line Checks, Route Checks, LOE, LOS, or LOFT. Any "Line Checks," "Route Checks," LOS, LOE, or LOFT (or other equivalent AQP events) conducted by the operator should be consistent with, and ensure compliance with, applicable provisions of the AWO program of the operator.

7.8. Special Qualification Requirements for Particular Nonprecision, Category I, or Category II Operations. Certain authorizations may require additional Nonprecision, Category I, or II training. Additionally, special qualification may be required for particular instrument procedures, particular types of procedures, or particular airports as determined appropriate by the operator or the FAA.

7.8.1. HUD or Autoland. Use of Certain RVR 1800 Authorizations based on HUD or Autoland. Use of lower than standard Category I minima based on use of HGS guidance or Autoland may be authorized. Such authorizations may be requested from the CHDO, and are approved on a case by case basis by AFS-400.

7.8.2. Use of Lowest Category I Minima at Certain Obstacle Limited or Restricted ILS Facilities. Operators may receive an authorization to use the lowest Category I minima at runways otherwise restricted to use higher minima due to near-in obstacles (e.g., KDTW RW21R). Such authorizations may be requested from the CHDO, and are approved on a case by case basis by AFS-400.

7.8.3. Simultaneous Operations Using PRM Radar. For pilot procedures regarding Simultaneous Operations using PRM Radar, see the Aeronautical Information Manual. When these procedures are used by an operator, flightcrews should be suitably briefed on their appropriate use, and how and when to decline their use.

7.8.4. Simultaneous Operations With Converging Approaches and Coordinated Missed Approaches. Simultaneous Operations with Converging Approaches should be addressed if used by the operator. Pilots should be familiar with how to determine if such operations are in effect, how to program the procedure in the FMS, if applicable, how to determine if their airplane can comply with an applicable missed approach clearance for that particular landing, how to determine if there are any special Standard Instrument Approach Procedure (SIAP) or airport procedures to be used, what to do in a contingency, and circumstances in which it may be appropriate to decline such a clearance.

7.8.5. Simultaneous Runway Operations. Simultaneous Operations with land and hold short operations (LAHSO) ATS clearances should be addressed if used by the operator. Pilots should be familiar with how to determine if such operations are in effect, if their airplane can comply with a LAHSO clearance for that particular landing, how to determine if there are any special airport markings or lighting to be used, what to do in a contingency if the other airplane does not respond as expected or cannot stop in the allocated distance, if a failure occurs on either airplane, or if either or both airplanes must reject the landing, and circumstances in which it may be appropriate to decline such a clearance.

7.8.6. Special Qualification Instrument Procedures or Types of Instrument Procedures. The operator may identify certain instrument procedures or types of procedures as requiring special flightcrew qualification (e.g., due to use of particular flight guidance systems or procedures, or requirements for FTE management, or procedure complexity).

7.9. Particular Approach System/Procedure Qualification.

7.9.1. Autoland Qualification. Unless otherwise specified by FAA in OpSpecs, autoland qualification for Category I or II may be completed through use of Level A, B, C, or D simulation, or by observation of an autoland during Initial Operating Experience (IOE). When using simulation, at least one normal autoland and one autoland with a failure or non-normal condition requiring pilot intervention or takeover should be completed.

7.9.2. Head Up Display Qualification.

a. Nonprecision, Category I, or Category II. A recommended list of flight training events for Nonprecision, Category I, or Category II qualification is shown below. For qualification, the PF (usually the Captain) and PNF (usually the F/O) should each accomplish their respective duties. It is desirable but not required that the PNF receive at least some exposure to use of the HUD as PF, in order to be familiar with its operation, characteristics, and limitations.

(1) Take-offs:

- Two Take-offs (RVR at lowest authorized minima - e.g., RVR300)
- One with an engine failure leading to continuation
- One with any failure leading to an RTO
- One windshear event during take-off

(2) Landings:

- Five for the lowest Nonprecision, Category I, or Category II qualification as applicable (three with, two without failures)

- Five Missed Approaches/balked landings due to a failure

- One Nonprecision circling approach

b. Simultaneous Nonprecision, Category I/II/III Qualification (also see AC120-28D). A recommended list of flight training events for Simultaneous Nonprecision, Category I/II/III qualification is shown below. The PF/PNF should each accomplish respective duties as in paragraph a. above. In addition, it is appropriate that the PNF receive at least limited exposure to use of the HUD as PF. The number of events for the PNF, however, may be determined by the operator considering the experience and familiarity of the PNF with HUD operations.

Landings:

- Two Category I (one with, one without failure)

- One Category II (with or without a failure)

- Five Category III (three with, two without failures)

- Five Missed Approaches/balked landings due to a failure

- One Nonprecision circling approach, if applicable for that operator

7.9.3. RNAV Approach Qualification. Requirements to conduct RNAV approaches (e.g., for /E, /F, or /G qualified airplanes) that already routinely use LNAV/VNAV autoflight modes, are as follows:

a. The flightcrew must know how to properly use the applicable navigation system(s) for the particular types of approaches to be flown. This is typically addressed in training as a flight crewmember initially qualifies to fly a particular type or variant.

b. The flightcrew should have, know, or be able to do each of the following items.

(1) Have access to the appropriate instrument chart(s) (e.g., SID, STAR, or approach plates) for the applicable procedures;

(2) Know how to properly load the procedure(s) and any associated transitions, string related waypoints, address discontinuities, enter associated data (e.g., path constraints, altitude constraints, speed constraints, winds, anti-ice initiation altitudes); and

(3) Know how to properly fly the procedure(s) (e.g., operate the airplane properly to stay on the designated LNAV and VNAV path, and meet constraints, regardless of autoflight mode(s) selected for use, or unexpected mode changes or reversions).

c. The flightcrew must know how to properly apply applicable flight information (e.g., NOTAM's), if any, for the navigation system and route of flight (e.g., to properly deselect relevant NAVAIDs that are out of service, or could otherwise cause a problem such as a map shift, if they could adversely and significantly degrade navigation system performance).

d. The flightcrew must know how to apply or accomplish any routine or special flight deck procedures specified by the operator for the approach type used or for the particular approach to be flown, including:

(1) Tuning or setting associated radios, altimeters, radar altimeters,

(2) Setting reference bugs and Mode Control Panel (MCP) altitudes, speeds, or headings,

(3) Selecting or arming appropriate Autopilot Flight Director System (AFDS) modes,

(4) Performing any necessary navigation performance/map validity verification checks to ensure suitable navigation performance. Examples of acceptable verification methods typically include:

(a) A cross check of Flight Management System (FMS) position with raw data prior to passing an FAF or FAP,

(b) A flightcrew assuring that the FMS is using an acceptable updating mode during the descent check (e.g., DD IRS (3)), and no map shift is evident prior to passing the FAF or FAP,

(c) Periodically monitoring situation information navigation information for consistency with RNAV position information that is displayed on the PFD or ND, or

(d) Comparison of RNAV position or other parameters (e.g., radio altitude at a known waypoint or position) with other independent sources of acceptable position information (e.g., cross check an LNAV path with a path depicted by radar or TAWS, if applicable) which assures the validity of the navigation system position estimate (e.g., cross checking VNAV with radio altitude, if applicable).

(e) Know how to verify navigation data base loads for currency, verify waypoint and critical waypoint validity, if applicable. Know how to verify appropriate levels of RNP, as applicable. Know how to verify suitable sensor performance if applicable (e.g., acceptable IRS drift rate performance, DME-DME, VOR-DME or GPS updating).

(5) Configuring the airplane at appropriate times, or in conjunction with ATS clearances (speed intervention adjustments), and addressing or otherwise appropriately responding to related airplane or system status annunciations, advisories, alerts, cautions, or warnings.

e. The flightcrew must be familiar with any unique issues particular to a specific approach or family of approach procedures (e.g., any special flight guidance procedures or actions necessary to accomplish the procedure(s) such as with the flight director, autopilot, autothrottle, or FMS).

f. The operator must have the pertinent OpSpecs paragraph and the flightcrew must be aware of any operationally significant OpSpec provisions that relate to the procedures to be flown.

g. Each operator should ensure that effective methods are used to implement applicable RNAV procedures to ensure that in line operations each pilot can perform assigned duties reliably and expeditiously for each procedure to be flown, both in normal circumstances, and for probable non-normal circumstances (e.g., engine failure and other representative QRH, or equivalent, non-normals).

h. The best method or method(s) to be used by a particular operator to ensure competency in flying RNAV procedures may vary significantly from operator to operator. Methods, level and extent of training and checking, and recency may depend on the type of procedures used by the operator, the airplane/FMS types and any autoflight systems used, level of familiarity or experience of flight crewmembers with the FMS, autoflight, and the RNAV procedures used, the complexity and criticality of procedures to be flown, and the environment in which the procedures are flown.

7.9.4. Nonprecision, Category I, or II Operations with an Engine Inoperative.

a. Nonprecision, Category I.

(1) An engine-out approach and landing at an airport reporting Nonprecision, Category I, or Category II low visibility weather is not desirable, but may be inevitable in certain conditions. Training should be completed to ensure that pilots, and dispatchers if applicable, can properly identify and select the nearest suitable airport (2 engine airplanes), or a safe airport (3 or more engine airplanes) to safely conduct an engine(s) inoperative landing. If applicable, flightcrews and dispatchers should demonstrate knowledge of factors influencing selection of a suitable airport for landing and safe completion of the approach considering factors such as the following:

(a) Engine (or engines) inoperative airplanes configuration (e.g., degree of thrust asymmetry, appropriate flap settings, adjusted reference speeds, remaining reverse thrust capability and use);

(b) Other potentially affected airplane systems (e.g., electrical or hydraulic);

(c) Weather Conditions (winds, turbulence, ceiling and visibility, RVR, icing, windshear, crosswind or tailwind components, recency and accuracy of weather information);

(d) Use of appropriate minima for the configuration and possible need for adjustment of approach and landing minima to suit the particular circumstances;

(e) Special minima considerations that might be appropriate (e.g., engine-out missed approach obstacle or terrain assurance and balked landing obstacle avoidance considerations, consideration of subsequent engine failure (airplanes with more than 2 engines));

(f) Selection of most favorable NAVAIDs, runway, or runway conditions (e.g., regarding braking friction, clutter);

(g) Availability of emergency services;

(h) Airport and procedure familiarity;

(i) Nearby terrain or obstruction considerations;

(j) MEL status; and

(k) Pilot recency of experience.

(2) Operators should at least be familiar with the factors listed above, and should provide the necessary training to flightcrews, and dispatchers if applicable, to address these factors because an engine failure may occur during or after take-off, while en route, prior to approach, after passing the final approach fix, at or below MDA or DA(H) leading to either a landing or go-around, or during missed approach.

b. Category II. For Category II, the factors listed above for training and qualification for Nonprecision and Category I should be considered, and in addition the following should be addressed. For flightcrews authorized to initiate a Category II approach with an inoperative engine either through Category II flight planning or dispatch procedures or for engine failures which occur en route, appropriate training should be completed to ensure that flightcrews can properly apply the provisions of paragraphs 5.17. For airlines that do not authorize the initiation of a Category II approach with an engine inoperative as an approved procedure, flightcrews should at least be familiar with the provisions above for Nonprecision and Category I regarding an engine failure after passing the final approach fix.

7.9.5. Enhanced Vision Systems (EVS) or Synthetic Vision Systems (SVS), or Independent Landing Monitor Systems (ILM). Training required for EVS or SVS, or ILM systems may be specified by FAA based on successful completion of proof of concept testing, as applicable. Pertinent requirements are as specified in the applicable FSB report.

8. AIRPORTS, NAVIGATION FACILITIES, AND METEROLOGICAL CRITERIA.

8.1. Navigation Facilities. A system must meet appropriate accuracy, integrity, continuity and reliability performance standards of U.S. Standard Flight Inspection Manual, FAA Order 8200.1. Foreign airports served by U.S. air carriers or commercial operators under part 121, 125, 129, or 135 may be approved in accordance with the provisions of pertinent ICAO Annexes, Standards, or Recommended Practices (SARPS), on the basis of a comparable level of safety. (Also see FAA Order 8260.31.)

8.1.1. Use of Standard Navigation Facilities. U.S. Nonprecision and Category I approaches may be approved as published by part 97 SIAPS or as special procedures in OpSpecs.

> **NOTE: The applicable ground facility must be maintained to the appropriate level of operation authorized. For example, if Category II minimums are authorized on a Category I facility, that facility must be maintained to Category II standards IAW FAA Order 8200.1.**

Category II operations may be approved on standard U.S. or ICAO navigation facilities as follows:

a. U.S. ILS facilities for which part 97 Category II procedures are published;

b. Other U.S. ILS facilities deemed acceptable by AFS-400 for the type of airplane equipment and minima sought;

c. Foreign airports meeting ICAO criteria (ICAO Annex 10, ICAO Manual of All Weather Operations DOC 9365/AN910, etc.) and which are promulgated for use in Category II operations by the "State of the Aerodrome;" and

d. Category II operations require facilities assessed and classified at least through ILS point "D" (e.g., II/D/2). (Point "D" is 12 ft. above the runway centerline and 3000 ft. from the runway threshold in the direction of the localizer.)

8.1.2. Use of Other Navigation Facilities or Methods. Nonprecision, Category I, or Category II operations may be approved using other types of navigation facilities or using other acceptable position fixing and integrity assurance methods, if proof of concept demonstrations are successfully completed and found acceptable to the FAA. The navigation facilities require flight inspection IAW FAA Order 8200.1.

8.2. Category II.

a. Category II procedures are based on both navigation and visual guidance systems. The navigation system must be capable of guiding an airplane to the runway reference datum (e.g., the ILS, MLS, GLS based glide path reference datum) with appropriate accuracy.

b. In order for a runway to qualify for Category II operations, the runway must be capable of supporting the lowest Category I minimums. Runways which do not meet this criteria but where an operational or other evaluation identifies that an equivalent level of safety exists, may be authorized appropriate Category II minimums after completion of an appropriate evaluation. Flight Standards Service shall conduct such an evaluation on a case-by-case basis.

8.3. Lighting Systems. The lighting system should provide suitable visual guidance from at least the point where an approaching airplane is at the lowest applicable DH, through the remainder of the approach, flare, landing, and rollout. Lighting systems are specified by standard OpSpecs, part 97 SIAPS, or any special provisions or procedures identified in OpSpecs. The system should consist of at least the following components or capabilities:

a. Approach Lighting System. Lighting standards are as outlined in FAA Order 1010.39, as amended, except that a negative approach light plane gradient is not permitted in the inner 1500 ft. zone prior to threshold (unless otherwise approved by AFS-1). Where required, approved flush approach lighting system may be installed (i.e., for a displaced landing threshold). For Special Nonprecision and Category I procedures authorized through OpSpecs, approach lighting at least equivalent to a MALSR should be installed, unless a different approach lighting configuration is approved by FAA for use by each applicable operator.

b. Touchdown Zone Lighting System. A lighting system should be provided defining the runway TDZ and conforming to AC 150/5340-4C, Installation Details for Runway Centerline Touchdown Zone Lighting Systems, as amended. For Special Category II procedures authorized through OpSpecs, TDZ lighting need not necessarily be installed if the runway's lighting configuration is reviewed and approved by FAA for use by each applicable operator (e.g., based on use of autoland or HUD guidance systems).

c. Centerline Lighting System. A centerline lighting system defining the runway centerline and conforming to AC 150/5340-4C, as amended, using L-843 and L-850 runway centerline lighting systems (or equivalent) should be provided. For Special Category II procedures authorized through OpSpecs, centerline lighting need not necessarily be installed if the runway's lighting configuration is reviewed and approved by FAA for use by each applicable operator (e.g., based on use of autoland or HUD guidance systems).

d. High Intensity Runway Edge Lighting. A high intensity runway edge lighting system (or equivalent) should be provided defining the lateral and longitudinal limits of the runway and conforming to AC 150-5340-24, Runway and Taxiway Edge Lighting System, as amended.

e. Taxiway Turnoff Lighting Systems. Unless otherwise approved for Special Category II procedures authorized through OpSpecs, taxiway turnoff lighting systems, stop bar, runway guard lighting, and critical area taxiway lighting designations should be provided in accordance with AC 120-57, Surface Movement Guidance and Control System, as amended, and the AC 150/5340 series, as amended.

f. Exceptions may be authorized only if an equivalent level of safety can be demonstrated by an alternate means (e.g., substitution for required approach lighting components due to use of an approved airplane system providing equivalent information or performance, such as use of an autoland system, head up display (HUD) with inertially augmented flight path vector display), or availability of redundant, high integrity, computed or sensor based (e.g., high resolution radar) runway information, suitably displayed to a pilot.

8.4. Marking and Signage. Marking and signage are as specified by the FAA in the 150/5300 series AC's, except as otherwise authorized by AFS-400.

a. Airports approved for Category II operations must include the following runway and taxiway markings and airport surface signs, or ICAO equivalent, unless approved by AFS-400 (e.g., for foreign airports):

- U.S. Standard Precision Instrument Runway Markings,
- U.S. Standard Taxiway edge and centerline Markings, and
- Runway signs, taxiway signs, hold line signs, taxiway reference point markings (if required by Surface Movement Guidance and Control System (SMGCS)), and NAVAID (ILS) critical area signs and markings.

b. For Category II, markings and signs must be in serviceable condition, as determined by the operator or FAA CHDO. Markings or signs found in an unacceptable condition should be reported to the appropriate airport authority and CHDO. Operators should discontinue Category II use of those areas of airport facilities or runways where unsafe conditions are known to exist due to inadequate markings or signs, until remedial actions are taken by the airport authority (e.g., snow removal, rubber deposit removal on runway touchdown zone markings or centerline markings, critical area hold line or runway centerline marking repainting, runway hold line sign snow removal).

8.5. Facility Status Remote Monitoring.

a. Remote facility status monitoring should be provided for the following NAVAIDS and visual aids (see FAA Order 6750.24).

(1) NAVAIDs.

(2) Approach lighting system.

(3) Relevant electrical power sources or systems.

(4) Runway edge, centerline and TDZ lights.

(5) Critical taxiway lighting, runway guard lights, and stopbars.

b. If not provided, a method to assure timely reporting of failures reported to ATS or the airport to flightcrews must be established.

8.6. Facility Status Monitoring by Periodic Inspection or After Reported Failures.

a. The following systems may require inspection by airport management or FAA personnel or pilot reports to determine if they are operating in accordance with specified criteria, reference AC 120-57. Monitoring procedures should be capable of detecting when more than 10 percent of the lights are inoperative. The lighting system/configuration should be considered inoperative when more than 10 percent of the lights are not functioning. Taxiway lights and individual airport/runway lights do not have to be remotely monitored. However, when visual aid lighting systems which support Category II are monitored by observation, the inspection interval should ensure that undetected failures of more than 10 percent of the lights, or more than two adjacent lights would be unlikely, taking into consideration lamp expected life, environmental conditions, etc. The procedure to visually verify operation of runway edge, centerline, and TDZ lights should specify that a visual inspection take place within one day prior to commencement of anticipated Category II operations, or at least daily for continued Category II operations. The following systems should be considered:

(1) Touchdown zone and centerline lights.

(2) Runway edge lights.

(3) Runway markings.

(4) Runway guard lights.

(5) Taxiway centerline lights.

(6) Taxiway clearance bar lights.

(7) Taxiway signs.

(8) Taxiway markings.

b. For Special Category II procedures authorized through OpSpecs; NAVAID, lighting, and marking monitoring may be authorized for each operator if a procedure is equivalent to the above provisions, and is approved by FAA considering use by each applicable operator.

8.7. Low Visibility Surface Movement Guidance and Control System (SMGCS) Plans. Surface movement guidance and control plans are recommended for operations below Category I. U.S. airports conducting take-off or landing operations below 1,200 ft. RVR (Category III) are required to develop a Surface Movement Guidance and Control System (SMGCS) plan. Where such plans are used, operators intending authorization for Category II should coordinate with the airport authority regarding the use of a SMGCS plan prior to OpSpec authorization for that airport. Equivalent coordination should be completed at foreign airports if such a plan is used by that airport.

a. SMGCS operations facilitate low visibility take-offs and landings and surface traffic movement by providing procedures and visual aids for taxiing airplanes between the runway(s) and apron(s). Specific low visibility taxi routes are provided on a separate SMGCS airport chart. SMGCS operations also facilitate the safety of vehicle movements that directly support airplane operations such as airplane rescue and fire fighting (ARFF), and follow-me services, towing and marshaling.

b. AC 120-57 describes the standards and provides guidance in implementing SMGCS operations such as aircrew training, etc. An operator intending authorization for Category III operations should coordinate with the airport authority regarding their SMGCS plan. Equivalent coordination is also applicable at foreign airports if such a plan is used by that airport.

c. For low visibility operations requiring a SMGCS plan, separation of at least 500 ft should typically exist between the centerline of any runway to be used and the centerline of any adjacent taxiway. When this runway to taxiway distance is less than 500 ft, an on-site evaluation based on a case by case basis may be appropriate to establish SMGCS procedures.

8.8. Meteorological Services and RVR.

8.8.1. Meteorological Services.

a. Standard meteorological reporting required by part 121 and 135 is acceptable for Nonprecision and Category I operations.

b. For Category II operations, appropriate meteorological services (e.g., RVR, RVV, METAR, METAF, Braking Action, NOTAM, reports, as applicable) are necessary for each airport/runway intended for use by an operator for Category II, unless otherwise approved by AFS-400. Foreign airports should meet criteria of ICAO Doc 9365/AN910, second edition, or later.

8.8.2. RVR Availability and Use Requirements.

8.8.2.1. RVR Availability. An RVR system should be provided to support Category II instrument procedures. For U.S. operators, RVR is considered to be an instrumentally derived measurement system reporting minimum visibility in units of feet or meters, located adjacent to the applicable runway. For Category II, RVR availability requirements for TDZ, mid runway (MID), and ROLLOUT RVR (or a corresponding international equivalent location) should be provided for any runway over 8000 ft in length. TDZ and ROLLOUT RVR should be provided for runways less than 8000 ft. Exceptions to this requirement for U.S. operators at foreign airports may be approved on a case by case basis by AFS-400, if an equivalent level of safety can be established. Factors considered due to local circumstances at foreign airports may include such issues as minima requested, landing field length requested, characteristics of prevailing local weather conditions, location of RVR sites or RVR calibration, availability of other supporting weather reports on nearby runways, etc.

a. "Inoperative RVR" requirements for dispatch or continuation of a particular flight operation are as specified in standard OpSpecs Part C, or any special OpSpecs provision unique to a particular operator. Unless otherwise approved, in special OpSpecs provisions, the controlling RVR must be operating for all operations based on RVR minima.

b. RVR use by operators and pilots (controlling and advisory RVR reports) is as specified in standard OpSpecs Part C. Since RVR reports can be influenced by runway light step settings; operators, and pilots should be familiar with and appropriately request adjustments to light step settings if necessary, to ensure best visual reference, and to appropriately affect RVR reported values.

c. If approved by AFS-1, Category II procedures may be approved on a case by case basis using only TDZ RVR, from adjacent or nearby runway RVR reports. Where transmissometers from other runways are used, they should typically be located within a radius of 2000 ft. of the applicable portion of the runway being served and provide a minimum of 1000 ft. coverage volume of the pertinent area along the intended runway.

d. New or replacement RVR systems should have the capability to report RVR ranging from a minimum value of 300 ft. to a maximum value of at least 6000 ft. Readout increments should be in at least 100 ft. increments up to at least 1000 RVR, and thereafter increments of 200 ft. to 3000 RVR. Where possible, RVR systems with a useful reporting range of 50 ft. RVR to 6500 ft. RVR are desirable. Preferred reporting increments are 50 ft. to 1000 RVR, 200 ft. to 3000 RVR, and 500 ft. beyond 3000 RVR. New or replacement systems should, if possible, be capable of reporting in units of feet or meters, so that if metric reports are introduced into the National Aviation System (NAS) or International Aviation System (INAS), RVR systems are easily capable of converting to use the alternate metric units.

e. FAA Standard 008, as amended, prescribes installation criteria for RVR equipment, and AC 97-1, as amended, describes RVR measuring equipment and it use.

8.8.2.2. RVR Use. In general, the controlling RVR for Take-off, Landing and Rollout are as follows:

a. Take-off. Where visibility minima are applicable, visibility must be reported sufficiently close to the take-off runway to be considered valid or applicable. The determination of acceptability, if not otherwise addressed by the FAA, may be determined on a case-by-case basis by AFS-400. For take-off operations the relevant RVR refers to any portion of the runway that is needed for take-off roll, including that part of the runway that may be needed for a rejected take-off.

(1) Category I weather conditions include: Touchdown zone RVR -- required and is controlling.

(2) Category II weather conditions include:

(a) Touchdown zone RVR – required and is controlling.

(b) Mid zone RVR – If installed, is required and controlling. A Mid zone RVR may be substituted for either an inoperative Touchdown zone RVR or inoperative Rollout zone RVR.

(c) Rollout zone RVR – Required for RVR less than 1600 ft. and is controlling.

b. Landing. Where visibility minima are applicable, visibility must be reported sufficiently close to the landing runway to be considered valid or applicable. The determination of acceptability, if not otherwise addressed by the FAA, may be determined on a case-by-case basis by AFS-400.

(1) Category I Weather Conditions include:

(a) Touchdown zone RVR -- required and is controlling.

(b) Mid or Rollout zone RVR – If installed, is advisory.

(2) Category II Weather Conditions include:

(a) Touchdown zone RVR – Required and is controlling.

(b) Mid zone RVR – Required for runways in excess of 8000 ft.; otherwise is advisory. If installed, Mid zone RVR may be substituted for an inoperative Rollout zone RVR.

(c) Rollout zone RVR – Required for RVR less than 1600 ft. and is advisory.

8.9. Alternate RVR Requirements For Short Field Length Operations. When approved as an exception in OpSpecs, airplanes capable of certificated landing or take-off distance of less than 4000 ft (using operational braking techniques) may be approved to use a single TDZ, MID, or ROLLOUT RVR as applicable to the part of the runway used. For such operations, RVR values not used are considered to be optional and advisory, unless the airplane operation is planned to take place on the part of the runway where a MID or ROLLOUT transmissometer is located.

8.10. Foreign Airports RVR Reporting Considerations. For RVR reporting and use outside the U.S., where international transmissometer locations may be specified by terms or locations other than TDZ, MID, or ROLLOUT as is done in the U.S. (e.g., International transmissometer locations A, B, C, D, or 1, 2, 3, 4), the operator may appropriately equate international transmissometer locations and reports to equivalent U.S. transmissometer positions and reports for the purpose of applying OpSpecs provisions. This applies to transmissometers installed, available, reports, or controlling minima determinations. Unless specifically precluded from doing so by the State of the Aerodrome, Airport Authority, or FAA, where the number of transmissometers available on a runway is different internationally than typically is available in the U.S. (e.g., 4 RVR locations on a runway internationally versus 3 in the U.S.), the operator may determine equivalent suitability of RVR availability, reporting, or minima controlling locations.

8.11. Critical Area Protection.

a. Airports and runways used for Category I and II must have suitable NAVAID (e.g., ILS) critical area protection, as applicable to the ground and airplane systems used. Procedures equivalent or more stringent than those in the U.S. AIM and FAA Order 7110.65 are required. Procedures consistent with ICAO DOC 9365/AN910 are acceptable for foreign airports. Where uncertainty regarding acceptability of foreign airport procedures is a factor, operators or CHDO's should contact AFS-400 (e.g., for foreign airports and runways listed on the FAA Category II status list where doubt exists regarding adequacy of procedures encountered in routine operations) for follow-up.

b. ILS critical areas will be marked and lighted to insure that ground traffic does not violate critical areas during specified operations. These areas may differ depending on the type of NAVAIDs used. Procedural methods may be used for Special Category II procedures, if assurance can be provided that critical areas can be suitably protected for each operator using the special procedure.

(1) Glide Path Critical Area. The glide path critical area for ILS installations is specified in FAA Order 6750.16B. The glide path critical area of the elevation antenna for MLS installations is specified in FAA Order 6830.5.

(2) Localizer Critical Area. The localizer critical area for ILS installations is specified in FAA Order 6750.16B. The Azimuth Antenna critical area for MLS installations is specified in FAA Order 6830.5.

8.12. Operational Facilities, Outages, Airport Construction, and NOTAM's. For operations to be initially authorized, operations to continue to be authorized, an airplane to be dispatched with the intention of using a facility described above, or an airplane to continue to its destination or an alternate with the intent of completing a Category I and II instrument approach procedure, operators must consider the status of components identified in paragraphs 8.1 through 8.7, as necessary for Category I or II (NAVAIDs, standby power, lighting systems, etc.) and take appropriate action for inoperative components. The following guidelines are considered acceptable unless otherwise precluded in OpSpecs:

a. Outer, Middle, or Inner marker beacons may be inoperative unless a Category I or II operation is predicated on their use (e.g., a DH is predicated on use of an Inner Marker due to irregular pre-threshold terrain, the airplane system requires use of a marker beacon for proper function).

b. Lighting systems are in normal status except that isolated lights of an approach light, or runway light system may be inoperative; approach light components not necessary for the particular operation such as REIL, VGSI, RAIL, etc. may be inoperative; lights may not be completely obscured by snow or other such contaminants if necessary for the operation (e.g., night).

c. NOTAM's for NAVAIDs, facilities, lighting, marking, or other capabilities must be appropriately considered for both dispatch, and continued flight operations intending to use instrument approach procedures. Operators and flightcrews must respond appropriately to NOTAM's that could adversely affect the airplane system operation, or the availability or suitability of instrument approach procedures at the airport of landing, or any appropriate alternate airport.

8.13. Use of Military Facilities. Military facilities may be used for Nonprecision, Category I, and II if authorized by DOD, and if equivalent criteria are met as applicable to U.S. civil airports.

8.14. Special Provisions for Facilities Used for ETOPS or EROPS Alternates. In addition to criteria specified above, an airport used as an ETOPS or EROPS Category II engine-out alternate should meet the following criteria:

a. Sufficient information about pre-threshold terrain, missed approach path terrain, and obstructions must be available so that an operator can ensure that a safe Category II landing can be completed, and that an engine-out missed approach can be completed from the specified DH.

b. Sufficient meteorological and facility status information must be available so that a diverting flightcrew, and dispatcher if applicable, can receive timely status updates on facility capability, weather/RVR, wind components, and braking action reports (if applicable), if conditions could or would adversely affect a planned Category II landing during the period of an ETOPS or EROPS diversion.

c. For any alternate airports not routinely used in normal operations by that operator's flightcrews (e.g., Keflavik, Iceland - BIKF), sufficient information should be provided for flightcrews, or dispatchers if applicable, to be familiar with relevant low visibility and adverse weather characteristics of that airport that might have relevance to an engine-out diversion operation (e.g., unique lighting or markings, any nearby obstructions or frequently encountered local windshear or turbulence characteristics, meteorological report, braking report, and NOTAM interpretation, appropriate ground taxi route and gate location information, emergency services available).

8.15. Alternate Airport Minima. Use of alternate airport minima are specified in Standard OpSpecs Part C paragraph C055. For applicability of "engine inoperative Category II" capability see paragraph 10.8.

8.16. Dispatch to Airports that are Below Landing Minima. In certain instances, an operator may dispatch an airplane to a destination airport even though current weather is reported to be below, or may be forecast to be below landing minima. This is to permit airplanes to begin a flight if there is a reasonable expectation that at or near the expected time of arrival at the destination airport, weather conditions are expected to permit a landing at or above landing minima. Dispatch to such airports is typically considered acceptable if the following conditions are met:

a. All requirements are met to use the landing minimum at the destination airport and at each alternate airport on which the dispatch is predicated (e.g., airplane, crew, airport facilities, NAVAIDs).

b. If lower alternate minima is applied based on availability of Category II capability, or Engine inoperative Category II capability, then each of the airborne systems otherwise applicable to the use of that capability must be available at the time of dispatch (e.g., flight guidance system, thrust reverse capability, as applicable to the airplane type and Category II authorization for that operator).

c. ETA at the destination airport considers any necessary holding fuel that may be required while the airplane waits for weather improvement.

d. Air traffic conditions are considered for potential delay due to other airplane arrivals or departures at the destination airport and at each alternate airport.

e. At least two qualifying alternate airports are available, the first of which considers the airplane flying to the below minima intended destination, then holding for a time as determined by the operator awaiting approach or weather improvement, then flying to the closest alternate, then completing an approach and missed approach at that airport, and then flying to the second alternate and landing with appropriate reserve fuel.

9. CONTINUING AIRWORTHINESS / MAINTENANCE.

9.1. Maintenance Program General Provisions. Unless otherwise approved by FAA, each operator should have an approved continuous airworthiness maintenance program (CAMP). The approved CAMP should typically include any necessary provisions to address Lower Landing Minima (LLM) or low visibility take-off IAW the operator's intended operation and the manufacturers recommended maintenance program, MRB requirements or equivalent requirements, or any subsequent FAA designated requirements (e.g., AD's, mandatory service bulletins). Emphasis should be on maintaining and ensuring total system performance, accuracy, availability, reliability, and integrity for the intended operations.

9.2. Maintenance Program Requirements. The maintenance program should be compatible with an operator's organization and ability to implement and supervise the program. Maintenance personnel should be familiar with the operator's approved program, their individual responsibilities in accomplishing that program, and availability of any resources within or outside the maintenance organization that may be necessary to ensure program effectiveness (e.g., getting applicable information related to the manufacturer's recommended maintenance program, getting information referenced in this AC such as service bulletin information).

a. Provision for low visibility operations may be addressed as a specific program or may be integrated with the general maintenance program.

b. Regardless of whether the maintenance program is integrated or is designated as a specific program for LLM, the maintenance program should at least address the following:

(1) Maintenance procedures necessary to ensure continued airworthiness relative to low visibility operations.

(2) A procedure to revise and update the maintenance program.

(3) A method to identify, record or designate personnel currently assigned responsibility in managing the program, performing the program, maintaining the program, or performing quality assurance for the program. This includes identification of any contractor or sub-contractor organizations, or where applicable, their personnel.

(4) Verification should be made of the lower landing minima systems and configuration status for each airplane brought into the maintenance or lower minimum program. Unless otherwise accepted by FAA, each airplane should meet relevant criteria specified by the applicable airplane manufacturer or avionics manufacturer for associated systems and equipment (e.g., Valid U.S. TC, appropriate STC records and compliance, assessment of status of any engineering orders, AD's, service bulletins or other compliance).

(5) Identification of modifications, additions, and changes which were made to qualify airplane systems for the intended operation or minima, if other than as specified in the AFM, TC, or STC.

(6) Identification of additional maintenance requirements and log entries necessary to change minima status.

(7) Any discrepancy reporting procedures that may be unique to the low visibility program. If applicable, such procedures should be compatibly described in maintenance documents and operations documents.

(8) Procedures that identify, monitor, and report lower minimum system and component discrepancies for the purpose of quality control and analysis.

(9) Procedures that define, monitor, and report chronic and repetitive discrepancies.

(10) Procedures that ensure airplanes remain out of lower minimum status until successful corrective action has been verified for chronic and repetitive discrepancies.

(11) Procedures that ensure the airplane system status is placarded properly and clearly documented in the airplane log book, in coordination with maintenance control, engineering, flight operations, and dispatch, or equivalent.

(12) Procedures to ensure the downgrade of an airplane low visibility capability status, if applicable, when maintenance has been performed by persons other than those trained, qualified, or authorized to use or approve procedures related to low visibility operations.

(13) Procedures for periodic maintenance of systems ground check, and systems flight check, as applicable. For example, following a heavy maintenance, suitable checks may need to be performed prior to return to service.

(14) Provisions for an airplane to remain in a specific low visibility capability status (e.g., Category II, Fail-Operational, Fail Passive) or other designated operational status used by the operator.

(15) Provision should be made for periodic operational sampling of suitable performance. Typically, at least one satisfactory approach should have been accomplished within a specified period approved for that operator, unless a satisfactory systems ground check has been accomplished. A recording procedure for both satisfactory and unsatisfactory results should be included. Fleet sampling is not typically acceptable in lieu of specific airplane assessment. To remain in CAT II status, at least one satisfactory operational use or satisfactory system ground check should be accomplished within the period specified by the airframe or avionics manufacturer or as approved by FAA.

NOTE: Maintenance programs meeting requirements for and approved for Category III typically are also considered acceptable for Category II. Airplane low visibility systems status, however, must be clearly identified for pilots, maintenance, and dispatch, when combined programs are used.

9.3. Initial And Recurrent Maintenance Training.

a. Operator and contract maintenance personnel including mechanics, maintenance controllers, avionics technicians, personnel performing maintenance inspection or quality assurance, or other engineering personnel if applicable, should receive initial and recurrent training as necessary for an effective program. The training curriculum should include specific airplane systems and operator policies and procedures applicable to low visibility operations. Recurrent training should typically be accomplished at least annually, or when a person has not been involved in the maintenance of the specified airplane or systems for an extended period (e.g., greater than 6 months). Training may lead to a certification or qualification (e.g., for lower landing minima "LLM") if the operator so designates such qualification in that operator's approved program.

b. The training should at least include, as applicable:

(1) An initial and recurrent training program for appropriate operator and contract personnel. Personnel considered to be included are maintenance personnel, quality and reliability groups, maintenance control, and incoming inspection and stores, or equivalent organizations. Training should include both classroom and at least some "hands-on" airplane training for those personnel who are assigned airplane maintenance duties. Otherwise, training may be performed in a classroom, by computer based training, in simulators, in an airplane or in any other effective combination of the above consistent with the approved program, and considered acceptable to FAA.

(2) Subject areas for training should include: Operational concepts, airplane types and systems affected, airplane variants and differences where applicable, procedures to be used, manual or technical reference availability and use, processes, tools, or test equipment to be used, quality control, methods for testing and return to service, signoffs required, proper Minimum Equipment List (MEL) application, general information about where to get technical assistance as necessary, necessary coordination with other parts of the operator's organization (e.g., flight operations, dispatch), and any other maintenance program requirements unique to the operator or the airplane types or variants flown (e.g., human factors considerations, problem reporting).

(3) Procedures for the use of outside vendors or vendors' parts that ensures compatibility to program requirements and for establishing measures to control and account for parts overall quality assurance.

(4) Procedures to ensure tracking and control of components that are "swapped" between systems for trouble shooting when systems discrepancies can not be duplicated. These procedures should provide for total system testing and/or removal of airplanes from lower minimum status.

(5) Procedures to assess, track, and control the accomplishment of changes to components or systems pertinent to low visibility operations (e.g., AD's, service bulletins, engineering orders, 14 CFR requirements).

(6) Procedures to record and report lower minimum operation(s) that are discontinued/interrupted because of system(s) malfunction.

(7) Procedures to install, evaluate, control, and test system and component software changes, updates, or periodic updates.

(8) Procedures related to the minimum equipment list (MEL) remarks section use, which identify low visibility related systems and components, specifying limitations, upgrading and downgrading.

(9) Procedures for identifying low visibility related components and systems as required inspection items (RII), to provide quality assurance whether performed in-house or by contract vendors.

9.4. Test Equipment/Calibration Standards. Test equipment may require periodic re-evaluation to ensure it has the required accuracy and reliability to return systems and components to service following maintenance. A listing of primary and secondary standards used to maintain test equipment that relate to low visibility operations should be maintained. It is the operator's responsibility to ensure these standards are adhered to by contract maintenance organizations. Traceability to a national standard or the manufacturer's calibration standards should be maintained.

9.5. Return To Service Procedures. Procedures should be included to upgrade or downgrade system status concerning low visibility operations capability. The method for controlling operational status of the airplane should ensure that flightcrews, maintenance and inspection departments, dispatch, and other administrative personnel as necessary are appropriately aware of airplane and system status.

a. The minimum level of system testing must be specified for each component and system. Aircraft should be returned to service in accordance with procedures recommended by the airframe or avionics manufacturer, or an alternate procedure approved by FAA. These procedures should be used after any maintenance activity or discrepancy to upgrade the aircraft to the type certificate specified category status (CAT II or III). Returning the aircraft to service with inoperative equipment must be done in accordance with the aircraft maintenance program and the MEL, with the category status downgraded if necessary. Onboard test equipment will be determined by the aircraft manufacturer to be appropriate for return to service to ensure the desired accuracy and integrity for low visibility operations. If the onboard test equipment is not suitable for return to service, additional testing will be required by the operator.

b. Contract facilities or personnel must follow the operator's FAA approved maintenance program before approving the airplane for RTS. The operator is responsible for ensuring that contract organizations and personnel are appropriately trained, qualified, and authorized.

9.6. Periodic Airplane System Evaluations. The operator should provide a method to continuously assess or periodically evaluate airplane system performance to ensure satisfactory operation for those systems applicable to Category II. An acceptable method for assuring satisfactory performance of a low visibility flight guidance system (e.g., autoland or HUD) is to periodically use the system and note satisfactory performance. A reliable record such as a logbook entry or computer ACARS record showing satisfactory performance within the previous 6 months for Category II is typically an acceptable method for assuring satisfactory system operation.

a. Periodic flight guidance system/autoland system checks should be conducted IAW procedures recommended by the airframe or avionics manufacturer, or by an alternate procedure approved by the FAA. For periodic assessment, a record should be established to show when and where the flight guidance/autoland system was satisfactorily used, and if performance was not satisfactory, to describe any remedial action taken.

b. Use of the flight guidance/automatic landing system should be encouraged to assist in maintaining its availability and reliability.

9.7. Reliability Reporting And Quality Control.

9.7.1. Reliability Reporting - Category I. No special "Reliability Reporting or Quality Control" requirements are applicable to Category I.

9.7.2. Reliability Reporting - Category II. For a period of 1 year after an applicant has been authorized for Category II, a monthly summary should be submitted to the certificate holding office. The following information should be reported:

a. The total number of approaches tracked, the number of satisfactory approaches tracked, by airplane/system type, and visibility (RVR), if known or recorded.

b. The total number of unsatisfactory approaches, and reasons for unsatisfactory performance, if known, listed by appropriate category (e.g., poor system performance, airplane equipment problem/failure, ground facility problem, ATS handling, lack of critical area protection, or other).

c. The total number of unscheduled removals of components of the related avionics systems.

d. Reporting after the initial period should be IAW the operators established reliability and reporting requirements.

9.8. Configuration Control/System Modifications. The operator should ensure that any modification to systems and components approved for low visibility operations are not adversely affected when incorporating software changes, service bulletins, hardware additions or modifications. Any changes to system components should be consistent with the airplane manufacturer's, avionics manufacturer's, industry, or FAA accepted criteria or processes.

9.9. Records.

a. The operator should keep suitable records (e.g., both the operator's own records and access to records of any applicable contract maintenance organization). This is to ensure that both the operator and FAA can determine the appropriate airworthiness configuration and status of each airplane intended for Category II operation.

b. Contract maintenance organizations should have appropriate records and instructions for coordination of records with the operator.

9.10. Part 129 Foreign Operator Maintenance Programs.

9.10.1. Maintenance of Part 129 Foreign Registered Airplanes. For part 129 operators of Foreign registered aircrafts (e.g., section 129.14 is not applicable), the cognizant Civil Aviation Authority (CAA) is the CAA of the operator. For those situations, FAA may implicitly accept that the maintenance program is considered to be acceptable if the cognizant CAA has approved it, and if the operator or CAA indicates that the program meets U.S. criteria, U.S. equivalent criteria (e.g., criteria such as JAA criteria), or ICAO criteria (e.g., Annex 6 and Doc 9365/AN910 "Manual of All Weather Operations"), and the cognizant CAA has authorized Category II U.S. operations. FAA then issues the pertinent part 129 Category II OpSpec based on the other CAA's approval for that operator. However, FAA reserves the prerogative to ensure competence of both the operator and authorizing and supervising CAA, depending on whether the CAA or operator are considered to be from a Category I, II, or III country (safety classification, not a low visibility landing classification), and if there have been any reported problems with the operator or CAA. Evidence of the operator satisfying or being consistent with the manufacturer's recommended maintenance program should serve as evidence of an acceptable maintenance program, regardless of the capability of the CAA or the operator, unless FAA has specifically addressed maintenance requirements beyond those of the manufacturer for that airplane type (e.g., required service bulletin compliance or Airworthiness Directive compliance related to the flight guidance system).

9.10.2. Maintenance of Part 129 Foreign Operated U.S. "N" Registered Airplanes. Foreign operators of U.S. "N" Registered Airplanes (e.g., those operators to which section 129.14 is applicable) should have maintenance programs equivalent to that required for a U.S. part 121 operator. Use of the part 91 provisions for General Aviation are not applicable or appropriate. POI approval of Category II OpSpecs for a section 129.14 operator may implicitly be considered to also accept the maintenance program adequacy. Accordingly, coordination between the applicable POI and PMI is necessary before part 129 OpSpec authorization is completed. FAA is ultimately the cognizant CAA for the maintenance program in this instance, if the airplane is N registered. However, FAA may accept the oversight of the operators CAA if that CAA is judged by FAA to have equivalent processes, criteria and procedures for oversight of maintenance programs (e.g., JAA countries). The basis for any such maintenance program should be the recommended airframe manufacturer (or avionics vendor) program, considering any adjusted MRB requirements.

10. APPROVAL OF UNITED STATES OPERATORS. Approval for Nonprecision, Category I, and II is through issuance of, or amendments to, OpSpecs. The authorizations, limitations, and provisions applicable to Nonprecision, Category I, and II operations are specified in Part C of the OpSpecs. OpSpecs authorizing reciprocating and turbopropeller-powered airplane Nonprecision, Category I operations that use ICAO standard NAVAIDs, ASR's, and PAR's are normally approved by the certificate holding district office without further review and concurrence, following satisfactory completion of the pertinent items below. Nonprecision, Category I turbojet, turbofan and propfan normally require regional flight standards review and concurrence before approval. All Category II operations and operations using NAVAIDs which are not ICAO-standard NAVAIDs (e.g., Loran C, ARA, OSAP and TLS) normally require both regional flight standards and AFS-400 review and concurrence before approval.

10.1. Operations Manuals and Procedures.

a. Appropriate Flightcrew Operating Manuals, Airplane Flight Manuals, Policy Manuals, Airplane Checklists, Quick Reference Checklists, Maintenance Manuals, Training Manuals or other equivalent operator documents (as necessary), must satisfactorily incorporate pertinent Nonprecision, Category I, and II provisions prior to Nonprecision, Category I, and II approval.

(1) Manuals. Prior to approval, appropriate flightcrew operating manuals, flight manuals, airline policy manuals, maintenance manuals, training manuals, and related airplane checklists, quick reference handbooks, or other equivalent operator information, must satisfactorily incorporate provisions pertinent to each category of operation. Information covered in ground training, and procedures addressed in flight training should be available to flightcrews, and to dispatchers as applicable, in an appropriate form for reference use.

(2) Procedures. Prior to approval of Nonprecision, Category I, or II operations, provisions of paragraph 6 of this AC that cover procedures, duties, instructions, or any other necessary information to be used by flightcrews, or dispatchers as applicable, should be implemented by the operator.

b. Flight crewmember duties during the approach, flare, rollout, or missed approach should be described. Duties should at least address responsibilities, tasks of the pilot flying the airplane and the pilot not flying the airplane during all stages of the approach, landing, rollout and missed approach. The duties of additional flight crewmembers, if required, should also be explicitly defined.

c. Specification of flight crewmember duties should address any needed interaction with dispatch or maintenance (e.g., addressing resolution of airplane discrepancies and return to Category II/III service).

d. The applicant’s qualification program should incorporate specific procedural responsibilities, appropriate to each category of landing minima being implemented, for the PIC and SIC in each of the ground training subject areas listed in paragraph 7.1, and each of the flight training subject areas listed in paragraph 7.2.

10.2. Training Programs and Crew Qualification.

a. Training programs, AQP programs (if applicable), crew qualification and checking provisions and standards, differences qualification (AC 120-53) if applicable, check airmen qualification, line check, route check, and IOE programs should each satisfactorily incorporate necessary Nonprecision, Category I, and II provisions, as applicable (see paragraphs 7.1 through 7.7). An acceptable method to track pertinent flight crewmember Nonprecision, Category I, and II qualification must be established.

b. For manually flown Nonprecision, Category I, and II systems (HUD, FD’s, etc.,) ensure that provisions are made for each flight crewmember to receive the appropriate training, qualification, and line experience before that particular flight crewmember is authorized to use the pertinent Nonprecision, Category I, and II minima.

10.3. Dispatch Planning (e.g., MEL, Alternate Airports, ETOPS). Appropriate provisions for MEL’s and Configuration Deviation Lists (CDL) should be made as necessary to address Nonprecision, Category I, and II operations. Dispatch procedures to ensure appropriate weather, field condition, facility status, NOTAM information, engine-out MAP performance, flightcrew qualification, airplane system status, and fuel planning pertinent to Nonprecision, Category I, and II should be implemented. For ETOPS operations, a satisfactory method to address item 8.10 above should be demonstrated.

10.4. Formulation of Operations Specification Requirements (e.g., RVR limits, DA(H) or MDA(H), equipment requirements, field lengths). Proposed OpSpecs should list pertinent approved airports/runways, RVR limits, required transmissometers, DA(H) use provisions, "Inner Marker based DH" provisions (if applicable), airplane equipment provisions for "normal" and, if applicable, "engine-out" operations, landing field length provisions, and any other special requirements identified by the CHDO or AFS-400 (ETOPS, Category II, etc.). The operator’s manuals, procedures, checklists, QRH’s, MEL’s, dispatch procedures etc. must be shown to be consistent with the proposed OpSpecs.

10.5. Operational/Airworthiness Demonstrations. Appropriate "airplane system suitability" and "operational use suitability" demonstrations must be completed as described in 10.5.1 and 10.5.2, unless otherwise specified by AFS-400. The purpose of these operational demonstrations is to determine or validate the use and effectiveness of the applicable airplane flight guidance systems, training, flightcrew procedures, maintenance program, and manuals applicable to the program being approved. Operators of airplanes having FAA approved AFM’s referencing this AC as the criteria used as the basis for Nonprecision, Category I, or II airworthiness demonstration already are considered to meet provisions of 10.5.1, and typically need only address provisions of 10.5.2. for verification of operational use suitability.

10.5.1. Airplane System Suitability Demonstration. FAA regulations addressing low visibility take-off and landing requirements and Nonprecision, Category I, and II are primarily operating rules addressed by parts 61, 91, 97, 121, 125, and 135. These provisions apply continuously, as defined at the time of a particular operation.

a. For Nonprecision, Category I approaches, basic type certification of an airplane for IFR is considered satisfactory. Operationally acceptable demonstrations addressing suitability of airplane systems for Category II must be successfully completed initially, and acceptable system status must be maintained by an operator to reflect compliance with current operating rules, to initially operate or continue to operate to Category II minima.

b. To minimize the need for repeating airplane system operational suitability demonstrations of airplane system components such as flight guidance systems, autoland, flight directors, HUD’s, flight instrument and alerting systems, radio altimeters, inertial systems, and air data systems for each operator, airplane system suitability is usually demonstrated in conjunction with airworthiness approval (TC or STC). This approach to determination of airplane system suitability is taken to optimize use of analysis and flight demonstration resources for operators, airplane manufacturers, avionics manufacturers, and FAA. Accordingly, airplane system suitability is normally demonstrated through an airworthiness approval meeting applicable provisions of appendices to this AC (or combined airworthiness/operational evaluation for new systems or concepts, or where otherwise necessary) Successful completion of this demonstration will be noted in the AFM.

c. If the AFM does not reflect completion of a Category II demonstration, then the operator may propose an assessment and demonstration program to establish Category II capability of an airplane or flight guidance system. In such instances, criteria of Appendix 2 may be used as a guideline to formulate the operator’s assessment and demonstration program. For such a program, the numbers of approaches conducted by the operator and the data collected to establish suitable performance and reliability should be equivalent to that which otherwise would be provided by an airworthiness demonstration IAW Appendix 2.

d. Airworthiness demonstration to an acceptable earlier version of AC 120-29, or equivalent criteria, may continue to be used for demonstration of airplane/airplane systems initially type certificated prior to issuance of this revision and having the earlier criteria as the type certification basis. However, previously demonstrated airplanes or airplane systems seeking additional Nonprecision, Category I, or Category II capability (e.g., for HUD, or GNSS operational approval) must meet criteria specified in this AC.

e. Acceptable results of such airworthiness evaluations are usually described in AFM Section 3 (Normal and Non-Normal Procedures).

f. For airplanes certified by FAA through section 21.29, certain foreign manufactured airplanes, any AFM provisions applicable to Nonprecision, Category I may be assessed for suitability. Assessment of provisions for Category II may vary and may require coordination between the CMO and AFS-400. In certain instances, AFM provisions may not be consistent with U.S. policy (Order 8400.10 or rules (OpSpecs) applicable to Category II. In such instances, coordination with AFS-400 is appropriate to provide guidance to operators regarding applicability of various AFM provisions (e.g., DH and RVR limitations, acceptable NAVAID use, alerting system use, required versus recommended crew procedures). As a general guideline, AFM’s meeting airworthiness standards recognized by or harmonized with the FAA (e.g., JAA, Transport Canada, etc.) may typically be accepted without further demonstration.

g. In the event of consideration of an AFM of an airplane certificated by a Foreign airworthiness authority other than as described above, or for additional operational approval for existing systems based on uncertain foreign AFM provisions, operational assessments IAW criteria in this AC, or equivalent criteria, may be necessary. In such instances, the applicable AEG or AFS-400 should be consulted. If necessary, AFS-400 may specify suitable criteria to apply.

10.5.2. "Operator Use Suitability" Demonstration. For Nonprecision, Category I, unless a CHDO otherwise specifies that approach demonstrations are necessary due to unusual circumstances or special situations, or as noted in 10.5.3 below for special systems such as "Autoland," operators may conduct Nonprecision and Category I operations without need for special demonstrations, if the airplane type AFM does not preclude the intended operation.

a. For Category II, at least one hundred (100) successful landings should be accomplished in line operations using the Category II or Category III system installed in each airplane type, unless fewer approaches are determined to be appropriate by the CHDO. Examples of situations where fewer than 100 approaches may be authorized by the CHDO include:

- credit for an operator also experienced in Category II or III operations
- addition of a different or new airplane type for an operator when that airplane type already has successful Category II or III experience with a similar operator
- certain long range airplanes using Category III procedures and training, but with interim limitations to use Category II minima

b. Regardless of credit permitted by the CHDO, if an operator is not aware of current Category II operations at a particular runway by some other operator and similar airplane type, it is a good practice for the operator to have conducted at least one approach using the Category II or III system to each runway intended for Category II operations in weather better than that requiring use of Category II minima. Such demonstrations may be conducted in line operations, during training flights, or during airplane type or route proving runs.

c. If an excessive number of failures (e.g., more than 5 percent result in unsatisfactory landings, system disconnects) occur during the landing demonstration program, a determination should be made for the need for additional demonstration landings, or for consideration of other remedial action (e.g., procedures adjustment, wind constraints, system modifications).

d. In unique situations where the completion of 100 successful landings could take an unreasonably long period of time due to factors such as a small number of airplanes in the fleet, limited opportunity to use runways having appropriate procedures, a reduction in the required number of landings may be considered on a case-by-case basis. Reduction of the number of landings to be demonstrated requires a justification for the reduction, and prior approval from the Flight Technologies and Procedures Division (AFS-400).

e. Landing demonstrations should be accomplished on U.S. facilities or international facilities acceptable to FAA. Demonstrations may be made on other runways and facilities if sufficient information is collected to determine the cause of any unsatisfactory performance (e.g., critical area was not protected). No more than 50 percent of the demonstrations may be made on such facilities.

f. If an operator has different models of the same type of airplane utilizing the same basic flight control and display systems, or different basic flight control and display systems on the same type of airplane, the operator should show that the various models have satisfactory performance. The operator need not conduct a full operational demonstration for each model or variant.

10.5.2.1. Data Collection For Airborne System Demonstrations. Each applicant should develop a data collection method to record approach and landing performance (e.g., form to be used by flightcrew). The resulting data and a summary of the demonstration data should be made available to the CHDO for evaluation. The data should, as a minimum, include the following:

a. Information regarding the inability to initiate an approach or identify deficiencies related to airborne equipment.

b. Information regarding abandoned approaches, stating the reasons the approach was abandoned and the altitude above the runway at which the approach was discontinued or the automatic landing system was disengaged.

c. Information regarding any system abnormalities which required manual intervention by the pilot to ensure a safe touchdown or touchdown and rollout, as appropriate.

10.5.2.2. Data Analysis. Unsatisfactory approaches using facilities approved for Category II or Category III where landing system signal protection was provided should be fully documented. The following factors should be considered:

a. ATS Factors. ATS factors that result in unsuccessful approaches should be reported. Examples include situations in which a flight is vectored too close to the final approach fix/point for adequate localizer and glide slope capture, lack of protection of ILS critical areas, or ATS requests for the flight to discontinue the approach.

b. Faulty NAVAID Signals. NAVAID (e.g., ILS localizer) irregularities, such as those caused by other airplanes taxiing, over-flying the NAVAID (antenna), or where a pattern of such faulty performance can be established should be reported.

c. Other Factors. Any other specific factors affecting the success of Category II operations that are clearly discernible to the flightcrew should be reported. An evaluation of reports discussed in paragraph 10.5.2.1 will be made to determine system suitability for further Category II operations.

10.5.3. Use of Autoland or Head-up-Guidance Systems at U.S. Type I Facilities or Equivalent (e.g., Type I ILS). For Category I, unless a CHDO otherwise specifies that autoland or HGS may not be used due to unusual circumstances or special situations, systems such as "Autoland" or "HGS" may typically be used at runways with facilities other than those with published Category II or III Instrument approach procedures. This is to aid pilots in achieving stabilized approaches and reliable touchdown performance to improve landing safety in adverse weather; for Category II or III training; to exercise the airborne system to ensure suitable performance; and for maintenance checks. Use of this capability may be particularly important for: pilot workload relief in stressful conditions of fatigue after long international flights; night approaches; cross winds or turbulence; when there may be other airplanes non-normal conditions being addressed; or to aid safe landing performance in otherwise adverse weather, restricted visibility, or with cluttered runways. This is true even though reported visibility may be well above minima (e.g., heavy rain distorting view out the windshield, snow covered runways where markings are not easily visible).

a. Operators may conduct autoland or HGS operations at such facilities without need for special demonstrations, if the airplane type AFM does not preclude the intended operation, and if for "Autoland" systems, Operations Specification Paragraph C61 is issued. Precautions to be taken for such operations include the following:

(1) The runway and associated instrument procedure should have no outstanding NOTAM's or other applicable "Notes" concerning the procedure precluding the use of the autoland or HGS system (e.g., it should not have notes such as "Localizer unusable inside the threshold," or "Glide Slope unusable below xxx feet"),

(2) Suitable ILS "Critical Area protection" (or equivalent) should be requested from ATS, if applicable. Similar to precautions for a Category II or III procedure, the flightcrew should remain alert to detect any evidence of unsuitable system performance, whether or not critical protection is being provided,

(3) The published ILS glide slope threshold crossing height (or equivalent) should be at least equal to or greater than that required for the airplane type, and

(4) The particular runway or procedure should not be precluded for "Autoland or HGS operations" by the operator due to known performance anomalies (e.g., not on a list of runways ineligible for or precluded from autoland or HGS operations as determined by that operator).

b. For operational approval of "Category II minima on Type I facilities," airborne systems including autoland or HGS are assessed for each particular airplane type and specific runway, IAW 10.5.2 above. (Also see Order 8400-13)

10.6. Eligible Airports and Runways. Nonprecision and Category I airports and runways are eligible as specified in part 97 SIAP's, ICAO accepted international procedures at foreign airports, or special procedures in OpSpecs. For Category II, an assessment of eligible airports, runways, and airplane systems must be made in order to list appropriate runways on OpSpecs. For Category II, runways authorized for particular airplanes IAW existing operations listed on the AFS-400 Category II status list may be directly incorporated in OpSpecs, or incorporated by reference if published part 97 SIAPS are available. Airplane type/runway combinations not shown should be verified by airplane system use in line operations at Nonprecision and Category I or better minima, prior to authorization for Category II. Airports/airplane types restricted due to special conditions (e.g., irregular pre-threshold terrain) must be evaluated prior to OpSpec authorization.

a. If applicable, the operator should identify any necessary provisions for periodic demonstration of the airplane system on runways other than those having Category II or III procedures (e.g., periodic autoland performance verification, using runways served only by a Category I procedure).

b. A list of facilities which have special Category I and II provisions and published Category II or III procedures can be viewed on the Internet using the following address: **http://www.faa.gov/avr/afs400/afs410.htm.**

10.7. Irregular Pre-Threshold Terrain and Other Restricted Runways. Not withstanding the fact that most airplane systems that have completed airworthiness demonstrations consider irregular terrain in the pre-threshold area, special operational evaluations are nonetheless appropriate for certain airports having irregular pre-threshold terrain conditions. Airports/runways with irregular pre-threshold terrain, or runways restricted due to NAVAID or facility characteristics are contained in CAT II/III Status List in Paragraph 10.6. These special evaluations consider each particular airplane type, the particular flight control system, and may include consideration of particular system elements such as the type of radar altimeters installed or other equipment. The need for such a special evaluation is contained in FAA Order 8400.8. CHDO's of operators desiring operations on these runways should contact AFS-400 to identify pertinent criteria and evaluation requirements. Criteria for the evaluation of irregular pre-threshold terrain airports is contained in Appendix 8 of AC 120-28D

10.8. Category II Engine-Inoperative Operations and ETOPS or EROPS Alternates based on Category II. Low visibility landing minima are typically based on normal operations. For non-normal operations, flightcrews and airplane dispatchers are expected to take the safest course of action to resolve the non-normal condition. The low weather minima capability of the airplane must be known and available to the flightcrew and, if applicable, airplane dispatcher.

a. In certain instances, sufficient airborne system redundancy may be included in the airplane design to permit use of an alternate configuration such as "engine inoperative capability" for alternate planning or initiation of a Category II approach. Use of an engine inoperative configuration is based on the premise that the engine non-normal condition is an engine failure that has not adversely affected other airborne systems. Systems which should be considered include systems such as hydraulic systems, electrical systems or other relevant systems for Category II that are necessary to establish the appropriate flight guidance configuration.

b. An alternate engine inoperative configuration is also based on the premise that catastrophic engine failure has not occurred which may have caused uncertain, or unsafe collateral damage to the airframe or aerodynamic configuration.

c. In instances when AFM or operational criteria are not met, and a Category II approach is necessary because it is the safest course of action, (e.g., in-flight fire), the flightcrew may use emergency authority. The flightcrew should determine to the extent necessary the state of the airplane and other diversion options to ensure that an approach in weather conditions less than Category I is the safest course of action.

d. Four cases are useful in considering engine inoperative Category II capability, and engine inoperative approach authorization:

(1) Flight planning (e.g., dispatch consideration of take-off, destination, or ETOPS or EROPS alternates) is based on airplane configuration, reliability, and capability for "engine inoperative Category II."

(2) An engine fails en route, but prior to final approach.

(3) An engine fails during the approach after passing the final approach fix, but prior to reaching the Decision Altitude (Height).

(4) An engine fails during approach after passing the Decision Altitude(Height).

e. Paragraph 5.17 provides criteria for demonstration of Category II engine out capability for the airplane. Paragraphs 10.8.1 through 10.8.5 below address criteria for use of an airplane with "engine inoperative Category II" capability.

10.8.1. General Criteria for Engine-Inoperative Category II Authorization. The following criteria are applicable to airplane systems intended to qualify for "engine inoperative Category II" authorizations. Airplanes demonstrated to meet provisions of Appendix 2 with an "engine inoperative" and that have reference to engine inoperative Category II capability in the FAA approved AFM are considered to meet the provisions listed below. Other airplanes which have an AFM showing only all-engine Category II capability may be operationally demonstrated for engine inoperative Category II capability.

a. The AFM or equivalent reference (e.g., operators manual) must suitably describe demonstrated approach and missed approach performance for the engine inoperative configuration, and the airplane must meet pertinent criteria otherwise required for all-engine Category II or equivalent criteria.

(1) Suitable performance information should also be available to the pilot and, if applicable, the airplane dispatcher, to ensure safe landing capability in the anticipated configuration and with anticipated speeds, and to establish safe go-around capability from DA(H) and, if applicable, for a balked landing from the TDZ (e.g., equivalent to an obstacle clearance take-off procedure).

(2) When assessing engine-out Category II capability, the following exceptions to all-engine Category II criteria may be used:

(a) The effects of a second engine failure when conducting Category II operations with an engine inoperative need not be considered;

(b) Flightcrew intervention to re-trim the airplane to address thrust asymmetry following engine loss may be permitted;

(c) Alternate electrical and hydraulic system redundancy provisions may be acceptable, as suited to the type design (e.g., bus isolation and electrical generator remaining capability must be suitable for the engine out configuration);

(d) Requirements to show acceptable approach performance may be limited to demonstration of acceptable performance during engine-out flight demonstrations (e.g., a safe approach to minima); and

(e) Approach or Landing system "status" should accurately reflect the airplane configuration and capability.

b. Suitable information about flight guidance system capability must be available to the flightcrew in flight, particularly at the time of a "continuation to destination" or "diversion to alternate" decision. This is to determine that the airplane can have an appropriate Category II approach capability when the approach is initiated (e.g., Non-normal checklist specification of expected configuration during approach, autopilot or flight director status annunciation of expected mode capability). Regardless of whether an operator is or is not operationally authorized for "engine inoperative Category II," it must be clear that having this airplane capability should not be interpreted as requiring a Category II landing at the "nearest suitable" airport in time (e.g., does not require landing at the nearest suitable Category II qualified airport - 14 CFR section 121.565).

c. The operator should consider system performance in appropriate weather conditions (e.g., winds, turbulence, or wind gradients) to make a determination as to whether any weather related restrictions or limitations are appropriate.

d. POI's should ensure that the following conditions are met:

(1) Operations must be IAW the "engine inoperative Category II" AFM provisions (e.g., within demonstrated wind limits, using appropriate flightcrew procedures), or within operationally determined equivalent provisions and procedures, if not specified in the AFM.

(2) Demonstrated/acceptable configurations must be used (e.g., AFDS modes, flap settings, electrical power sources, MEL provisions).

(3) Engine-inoperative missed approach obstacle clearance from the TDZ must be ensured. Suitable information should be readily available for flight planning (e.g., to the pilot or airplane dispatcher, if applicable).

(4) Appropriate training program provisions for the Category II engine inoperative approaches must be provided (see paragraph 7.2.6).

(5) Pilots must be aware that they are expected to take the safest course of action, in their judgment, in the event that unforeseen circumstances or unusual conditions occur that are not addressed by the "engine-inoperative" Category II demonstrated configuration (e.g., uncertain airplane damage, possible fire, weather deterioration).

(6) OpSpecs should identify the type of "engine-inoperative" Category II operations authorized.

10.8.2. Category II Engine Inoperative "Flight Planning."

a. The operator (e.g., pilot or if applicable, airplane dispatcher) may consider "engine inoperative Category II" capability in planning flights for a take-off alternate, en route (ETOPS or EROPS) alternate, re-dispatch alternate, destination, or destination alternate only if each of the following conditions are met:

(1) The operator (e.g., pilot or airplane dispatcher, if applicable) has determined that the airplane is capable of engine inoperative Category II.

(2) Appropriate procedures, performance, and obstacle clearance information must be provided to the flightcrew to be able to safely accomplish an engine inoperative missed approach at any point in the approach. If applicable, similar information must also be readily available to the airplane dispatcher.

(3) Appropriate operational weather constraints must be considered and specified as necessary regarding cross wind, head wind, tail wind limits considering the demonstrated capability specified in the AFM, or equivalent operationally demonstrated or specified provisions.

(4) Weather reports or forecast must indicate that specified alternate minimums or landing minimums will be available for the runway equipped with appropriate NAVAID and lighting systems and Category II procedures. The operation approval of engine inoperative capability should consider both the availability and reliability of meteorological reports and forecasts, the time factors involved in potential forecast accuracy, the potential for variability in the weather at each pertinent airport, and the ability for the flightcrew and, if applicable, airplane dispatcher to obtain timely weather reports and forecast updates during the time the flight is en route. Flight planning considerations must account for any expected ATS delays that might be experienced during arrival due to weather, snow removal, or other factors.

(5) Notices to airmen or equivalent information for airport and facility status should be reviewed to ensure that they do not preclude the accomplishment of a safe engine inoperative approach on the designated runway using approved Category II procedures (e.g., temporary obstructions). Any change in NOTAM status of facilities related to use of landing minima or alternate minima must be provided to the flightcrew in a timely manner while en route.

(6) If the engine inoperative configuration is different than a normal landing configuration, a means to determine that a safe landing distance is achievable should be addressed, considering the pertinent engine inoperative airplane configuration. This assessment is to ensure that sufficient runway is available consistent with the expected flap setting(s), speeds, and reverse thrust available configuration, or other factors that could pertain to an inoperative engine landing (e.g., reduced flap settings may be necessary for an engine inoperative approach).

(7) The expectation for runway surface condition based on pilot and operator (e.g., airplane dispatcher) interpretation of the available weather reports, field conditions, and forecasts is that the applicable runway is likely to be free from standing water, snow, slush, ice, or other contaminants at the time of landing. The flightcrew must be advised of any adverse change in this expectation while en route.

(8) Criteria otherwise applicable to "all engine" Category II, such as flightcrew or dispatcher training, flightcrew qualification, and availability of suitable procedures must also be addressed for the engine inoperative landing case, if they are not the same as for the "all engine" case.

(9) The operator is approved for operations based on engine inoperative Category II capability. In addition, operator responsibilities for engine inoperative approval should be equivalent to that of current normal operations when an en route landing system failure causes degraded landing capability. If an inflight failure causes further degradation of engine inoperative landing capability, the flightcrew (if applicable, in conjunction with the airplane dispatcher) should determine an acceptable alternative course of action (e.g., specification of different en route diversion options, revised fuel reserves plan, or revised flight plan routing).

(10) When engine inoperative Category II provisions are applied to identification of any destination or destination alternate, more than one qualifying destination alternate is required. This is to provide for the possibility of adverse area wide weather phenomena, or unexpected loss of landing capability at the first designated alternate airport.

(11) An appropriate ceiling and visibility increment is added to the lowest authorized minimums when credit for an alternate airport or airports is sought (e.g., 200 ft. DA(H) additive and appropriate RVR additive).

(12) The airborne system should be shown through "in-service" performance that from take-off to 500 ft. HAT on approach, system availability is at least 95 percent.

b. It should be noted that even if the airplane, flightcrews, and operator are authorized for engine inoperative Category II, flightcrews are not required to use Category II approach minima to satisfy requirements of section 121.565 regarding in-flight diversions. Not withstanding section 121.565, pilots may elect to take a safe course of action by landing at a more distant airport than one at which a Category II approach may be available. Conversely, pilots may elect to conduct the Category II approach as a safe or the safest course of action.

10.8.3. Category II Engine Inoperative En Route. For engine failure en route, a pilot may initiate an "engine inoperative" Category II approach under the following conditions:

a. The airplane flight manual normal or non-normal sections, or equivalent provisions of an operators manual specifies that engine inoperative approach capability has been demonstrated and procedures are available.

b. The pilot and, if applicable, airplane dispatcher have taken into account the landing runway length needed for the inoperative engine configuration and corresponding approach speeds, and obstacle clearance can be maintained in the event of a missed approach.

c. The pilot and, if applicable, airplane dispatcher have determined that the approach can be conducted within the wind, weather, configuration, or other relevant constraints demonstrated for the configuration.

d. The pilot and, if applicable, airplane dispatcher have determined from interpretation of the best available information that the runway is expected to be free from standing water, snow, slush, ice, or other contaminants.

e. The pilot is confident that the airplane has not experienced damage related to the engine failure that would make an engine inoperative Category II approach unsuccessful or unsafe.

f. The operator is approved and the pilot is qualified to conduct a Category II engine inoperative approach.

g. The pilot and, if applicable, airplane dispatcher consider that conducting a Category II approach is a safe and appropriate course of action.

10.8.4. Category II Engine Failure During Approach, Prior to Decision Altitude(Height).

a. If the airplane, operator, and flightcrew meet paragraphs 5.17 for the airplane and for operational use, a Category II approach may be continued if an engine failure is experienced after passing the final approach fix.

b. In the event that an airplane has not been demonstrated for engine inoperative Category II approach capability, or the operator or flightcrew have not been authorized for Category II engine inoperative approaches, then, regardless of flight phase, continuation of an approach in the event of an engine failure is permitted only IAW the emergency authority of the pilot to select the safest course of action.

NOTE: For some airplane configurations, it may be necessary to discontinue the approach after passing the final approach fix or final approach point; re-trim the airplane for an inoperative engine, and then re-initiate the approach in order to be able to appropriately complete a satisfactory Category II approach and landing.

10.8.5. Category II Engine Failure After Passing Decision Altitude(Height). If an engine fails after passing the Decision Altitude(Height), the procedure specified in the airplane flight manual, or a procedure specified by the operator in the operator's manual for normal or non-normal operations should be followed. Any Category II approval must consider the case of engine failure at, or after, DA(H). Standard OpSpecs are considered to address this case. "Engine inoperative Category II capability" is not specifically a factor in determining response to this situation.

10.8.6. Operators using Combined Category II and Category III Engine-Inoperative Approach Provisions. Unless otherwise specified by FAA, Category II and Category III engine inoperative authorizations and procedures may combined when the operator meets the more stringent criteria of AC120-28D for Category III. Separate demonstrations for AC 120-

29A and AC 120-28D is not necessary beyond any inherent differences between Category II and III operations (e.g., application of a DA(H) for Category II versus an Alert Height for certain Category III operations). Operational suitability demonstration programs, qualification programs, and operational provisions may be simultaneously established and used as long as procedures and systems applicable to the respective Category II and Category III capability and minima are appropriately applied. Eligible minima for any particular engine-inoperative operation should be no lower than the highest applicable authorized minima for the airplane, flightcrew, airport, procedure, or applicable OpSpecs limitation.

10.9. New Category II Operators.

a. New operators should follow demonstration period provisions of 10.5.2. Additionally, typical acceptable minima step down provisions approvable by FAA are as follows:

(1) Starting from Category I to Category II: First DH 150/RVR1600, after 6 months then DH 100/RVR1200

(2) Starting from Category I for Category III: See AC120-28D.

b. Each runway/procedure not already being used by any operator of a similar type airplane should be successfully demonstrated by a line service or an evaluation approach using the Category II system and procedures, in Category I or better conditions, for each applicable airplane/system type (e.g., B767, L1011). In addition, the operator must address special airports/runways as noted in the FAA Category II/III Status List.

10.10. Experienced Category II or Category III Operators for New Category II Authorizations.

a. Experienced operators are considered to be those operators having successfully completed their initial 6 month / 100 Category II or III approach or landing demonstration period, and have current OpSpecs authorizing use of lowest applicable or intended Category II minima.

b. Operators authorized for Category II using one class of system (e.g., autopilot) but who are introducing a significantly different class of system as the basis for a Category II authorization (e.g., manually flown Category II approaches using a HUD) are typically considered to be "New operators" for the purposes of demonstration period provisions and acceptable minima "step down" provisions for that class of system (see paragraph 10.9).

10.10.1. Category I or II At New Airports/Runways. For ILS or MLS, Category I or II operations may be conducted at facilities with a published part 97 SIAP, or equivalent, or with a "Special" instrument approach procedure typically without additional demonstration. For GLS, Category I operations may be conducted at facilities with a published part 97 SIAP or with a "Special" instrument approach procedure or equivalent for the particular operator(s) authorized to use the "special" procedure typically without additional demonstration. For other NAVAID systems or operator combinations (e.g., initial GLS Category II, other operators desiring to use a special instrument procedure developed by a different operator, TLS) demonstration of capability at new airport/runway is typically appropriate as determined by the CHDO. However, standard or special procedures for Category II other than those based on ILS or MLS may be added to an experienced Category II operator's OpSpecs for a similar procedure without further demonstration if the same or equivalent airplane/airplane system and procedure for the approach is already used by that operator or is shown on the FAA's CAT II Status List as being conducted at that facility by another operator with similar airplane or airborne system (e.g., acceptable HUD, GNSS operations). Otherwise, the operator may be requested by the CHDO to accomplish one or more line service landings at Category I or better minima to ensure satisfactory performance before authorizing Category II minima. Special runways on the FAA CAT II Status List (e.g., Irregular Terrain runways) typically require special evaluation for each airplane or system type (See Paragraph 10.7).

10.10.2. Category II With New Airplane Systems. Unless otherwise specified by AFS-400, experienced Category II operators may initially use new or upgraded airplane system capabilities/components to the lowest authorized minima established for those systems or components, or use reduced length demonstration periods, consistent with the new airplane systems to be used, FAA FSB requirements, and NAVAIDs, runways, and procedures to be used (e.g., New Category II HUD installations on B737-300s previously authorized for Category II for that operator based on autoland)

10.10.3. Adding a New Category II Airplane Type. Experienced Category II operators may operate new or upgraded airplane types/systems, or derivative types, using reduced length demonstration periods (e.g., less than 6 months/100 landings) when authorized by AFS-400. Demonstration requirements are established considering any applicable FAA FSB criteria, applicability of previous operator service experience, experience with that airplane type by other operators, experience of flightcrews of that operator for Category II and the type of system, and other such factors, on an individual basis. Appropriate minima reduction steps may also be established for an abbreviated demonstration period, consistent with prior operator experience, NAVAIDs and runways used, and procedures to be used, etc. (e.g., Newly acquired B757s being added to Category II OpSpecs, in addition to an operator's currently approved Category II A300 and MD-80 fleets).

10.11. Category II Program Status Following Operator Acquisitions/Mergers. Category II operators involved in acquisitions of other operators, or mergers, and their respective CHDO's, must ensure compatibility of programs, procedures, airplane systems, runways served, and any other relevant issues before amending OpSpecs, or advising the surviving or controlling operator of the status of Category II OpSpecs of the acquired or merged operator. If CHDO doubt exists regarding applicability or status of Category II OpSpec provisions for a resulting new, surviving, acquired, or merged carrier, AFS-400 should be consulted.

10.12. Initiating Combined Category I and II, or Category I, II, and III Programs for New Equipment Types. When appropriate provisions of this AC are used for Category I and II programs for a new equipment type (e.g., HUD), those programs may be initiated simultaneously for either a new Category II or Category II/III operator, or for an existing operator currently approved for Category II or III using other systems (e.g., ILS/FD).

10.13. United States Carrier Category I and II Operations at Foreign Airports. An applicant having U.S. Category I approval may be authorized to use that minima at foreign airports IAW its OpSpecs and Order 8260.31.

a. Once approved, the operator must comply with both FAA and local requirements. The operator must also ensure current status information for NOTAM's are available and advise its CHDO of incompatible requirements (use of OCA (H) etc.) for resolution by CHDO or AFS-400.

b. Although it is recognized that the systems at foreign airports may not be exactly IAW U.S. standards, it is important that any foreign facilities used for Category II provide the necessary information or functions consistent with the intent of the U.S. standards. Carriers desiring Category II approvals at foreign airports or runways not on the FAA-approved list should submit such requests through its FAA principal operations inspector to the Flight Technologies and Procedures Division, AFS-400, FAA Headquarters, Washington, D.C.

c. Figure 10.13-1 provides a checklist for carrier use to facilitate approval of Category II/III operations at facilities listed in the controlling states Aeronautical Information Publication (AIP). It should be used to ensure suitability of the intended facility and to verify conformance or equivalence with U.S. standards at foreign airports. Completion of this checklist must reflect achieved or completed status - not planned actions. For ICAO states that do not maintain an AIP, a copy of the NOTAM, obstruction data, and/or a reliable and regular method of correspondence with the charting services used by U.S. certificate holders must be attached. (See FAA Order 8260.31)

Figure 10.13 – 1.

FACILITY CHECKLIST FOR CATEGORY II/III

(FOREIGN FACILITIES ONLY)

AIRPORT (ICAO ID): _________ COUNTRY: _______________ DATE: ____________

Runway: ________ Length: _________ Width: _________ G/S Angle (deg.): ___________

Lowest Minima ________________________ (ft/m) Runway TCH _____________ (ft/m)

Special Limitations (if any):

.

LIGHTING:

Approach _____ TDZ _____ Centerline ____ HIRL ____ Stopbars _____

Other (e.g., PAPI):

.

MARKINGS:

Runway_______ Taxiway_______ Other (e.g., Taxiway Position) __________

Critical Area Protection Policy (ceiling/visibility or conditions):

LOC ____________________________ G/S ________________________________

METEROLOGICAL DATA: METAR’s ________ TAF’s ___________

TRANSMISSOMETERS: (locations/lowest RVR reported /readout step increment)

Touchdown _______________ Mid _________________ Rollout _______________

NOTAM SOURCE/CONTACT: ____

FIELD CONDITIONS SOURCE/CONTACT: ____

OBSTRUCTION CLEARANCE ASSESSMENT: (completion date)_______________________

Verified by: certificate holder ________, "state of the aerodrome" __________, other ___________

Irregular terrain a factor (Y/N): _______ Similar type airplanes currently operate (Y/N) __________

Attached procedure has been developed IAW:

FAA Handbook 8260.3B (TERPS) ____ ICAO PANS-OPS Doc. 8168-OPS/611, Vol-11 ____ or

Other Criteria Accepted by FAA ____ (indicate criteria) ______________________________

Facility reviewed IAW ICAO Manual of All Weather Operations, as revised:

(DOC 9365/AN910) Chapters 3, 5, and 6--DATE REVIEW COMPLETED: _________________

Name: _______

Title: _______

Signature:

Date: _______

Attachments: (request letter, aerodrome and approach charts (foreign and Jeppesen), foreign AIP info., etc.)

10.14. Category I and II Operations on Off-Route Charters.

a. Unless otherwise specified by AFS-400, experienced Category I operations using non-traditional systems (HUD, GNSS etc.) and Category II operators may receive authorization to use Category I and II minima at U.S. off-route charter airports and runways as follows:

(1) The runway has a published part 97 SIAP, or equivalent, or

(2) The runway must be on the FAA Category II status checklist, and not require special evaluation, or

(3) The airplane used must be the same as or equivalent to an airplane already using the facility by other U.S. operators (e.g., an off route charter with a B737/GNSS) could operate to runways having Category I and II Operations by an other operators B737-300 using same or equivalent system).

b. The OpSpec must authorize off-route charter Category I or II procedures, and

c. If applicable, the CHDO must be advised of the specific airports, airplanes, flightcrew qualifications and any special provisions to be used, prior to the intended operation.

10.15. Approval of Category I and II Minima. Applicants should submit documentation requesting approval to the FAA CHDO or FSDO responsible for that operator's certificate. The application should demonstrate compliance with the appropriate provisions of applicable paragraphs of this AC, particularly paragraphs 4, 5, and 7 through 12. Once reviewed and found acceptable, the application should be forwarded to AFS-400, through the regional All Weather Operations Program Manager, for their review and concurrence.

10.15.1. Content of Application. The application should contain information addressing both operations and maintenance programs for the applicable "type" airplane. If an operator has different models of the same "type" of airplane, see 10.5.2.f. The application should also include, as a minimum, the following issues that should be addressed in detail (see order 8400.10, Volume IV, Chapter 2).

a. Major components of a CAT 2 application include:

(1) Operating Procedures – autoland, autothrottles, flight director, instrument displays, decision and alert heights, ILS characteristics and limitations, airport lighting, signage, and markings, NOTAMS, transmissometers, etc.

(2) Crew Training – PF/PNF procedures, crew callouts, missed approach techniques, transition from instrument to visual flight conditions, crew duties (approach, flare, rollout or missed approach), etc.

(3) Simulator – initial and recurrent training and written testing

(4) Maintenance – initial and recurrent training, continued airworthiness program, return to service procedures, etc.

(5) Airplane and Equipment – fail-passive and/or fail-operational autoland systems, visual cues, cockpit cutoff angles, AFM, etc.

(6) Historical Data – autoland forms, etc.

(7) Minimum Equipment List (MEL) – proposed changes, etc.

(8) OPSPECS – proposed changes, etc.

b. During the period following the issuance of new or revised OpSpecs for Category II (typically 6 months), the operator must successfully complete a suitable operations demonstration and data collection program in "line service" for each type airplane, as the final part of the approval process. The approval process is considered to be completed following a successful demonstration period. This is to ensure appropriate performance and reliability of the operator's airplane, procedures, maintenance, airports, and NAVAIDs. This process must be completed before operations down to lowest requested minima are authorized.

c. When the data from the operational demonstration has been analyzed and found acceptable, an applicant may be authorized for the lowest requested minima consistent with this AC and applicable standard OpSpecs. Examples of minima step down provisions acceptable to FAA are provided in paragraph 10.9.

10.16. Operations Specification Amendments. The operator is responsible for maintaining current OpSpecs reflecting current approvals authorized by FAA. Once FAA has authorized a change for airplane systems, new runways, or other authorizations, appropriate and timely amendments to affected OpSpecs should be issued. Issuance of amendments to guidance or procedures in other related material such as the Flight Operations Manual or Training Program may also be required. When updated standard OpSpecs provisions are adopted by FAA, provisions of those updated OpSpecs should normally be applied to each operator's program in a timely manner.

10.17. Use of Special Obstacle Clearance Criteria (e.g., non-standard RNP Criteria). This paragraph addresses use of special criteria such as "Required Navigation Performance" (RNP) criteria. Pending implementation of RNP criteria for public use Standard Instrument Approach Procedures (SIAPS), obstacle assessments using special obstacle clearance criteria (e.g., criteria based on RNP capabilities) will be conducted on a case-by-case basis, only authorized as an element of special procedures for RNP qualified operators, using RNP qualified airplanes. Early application of RNP for special procedures is typically intended to apply to instrument procedure segments classified as a transition to a final approach segment, or to facilitate definition of suitable missed approach segments. Use of special obstacle clearance criteria or non-standard RNP criteria must be approved by AFS-400.

10.18. Proof-of-Concept Requirements for New Systems/Methods. Proof-of-Concept demonstration [PoC] as used in this AC is defined as a generic demonstration in a full operational environment of facilities, weather, flightcrew complement, airplane systems and any other relevant parameters necessary to show concept validity in terms of performance, system reliability, repeatability, and typical pilot response to failures as well as to demonstrate that an equivalent level of safety is provided.

a. Proof-of-Concept may be established by a combination of analysis, simulation and/or flight demonstrations in an operational environment. PoC is typically a combined effort of FAA airworthiness and operational organizations with the applicant, with input from any associated or interested organizations.

b. A typical PoC program consists of the following elements:

(1) Applicant submits a request to either FAA Aircraft Certification or Flight Standards.

(2) Meetings are arranged to include all disciplines involved: Aircraft certification; Flight Standards; National Resource Specialists; the applicant; and supporting personnel as necessary (e.g., Aviation Systems Standards, Air Traffic).

(3) A test plan is established which includes input from applicable FAA organizations, the applicant, and as applicable, industry user groups.

(4) The test plan should include as a minimum: system definition, operations procedures, qualification, training, weather and environment definition, normal and non-normal conditions to be assessed, flightcrew, test subject, and test crew requirements, test procedures, test safety constraints as applicable, assessment criteria, and analysis, simulator and test airplane requirements.

(5) PoC is conducted using agreed subject pilots, as appropriate.

(6) PoC data is collected in a real-time simulator environment and validated in a realistic airplane environment.

(7) FAA is responsible for assessing the PoC data that is typically provided to FAA as agreed by FAA and the applicant. FAA reports relevant findings to the applicant and if applicable, interested industry representatives.

(8) FAA operations and airworthiness organizations use the data to develop criteria for approval of type designs, certification

processes and procedures, operating concepts, facilities, flightcrew and maintenance qualification, OpSpecs, operations procedures, manuals, AFM’s, maintenance procedures, and any criteria necessary.

(9) FAA AC criteria for airworthiness and operational approval typically is a product of PoC assessment.

c. This process is presented pictorially in the following figure:

Figure 10.18-1.

10.19. RNP Qualification and Authorization. Operators may be authorized for RNP operations based on use of airplanes with an approved AFM specifying RNP capability. For such operations, in addition to AFM provisions, any provisions or constraints associated with that capability should be considered or applied (e.g., Airplane or avionics manufacturer’s guidance material, FCOM, or use assumptions made in associated documentation provided by the manufacturer to the operator or authority).

a. RNP authorizations for RNP capable airplanes as specified through an AFM may be generic and related directly to use of the provisions of the AFM (e.g., authorization to use RNP addresses any applicable AFM RNP levels and flightcrew procedures).

b. Authorization for use of RNP is through OpSpecs.

c. Detailed criteria for approval of RNP operations is published in a separate Advisory Circular.

11. FOREIGN AIR CARRIER CATEGORY I OR CATEGORY II AT U.S. AIRPORTS (PART 129 OPSPECS).

11.1. Use of ICAO or FAA Criteria.

11.1.1. Acceptable Criteria.

a. Criteria acceptable for use for assessment of foreign air carrier’s applications for Category II at U.S. airports includes this AC, equivalent JAA criteria, or the ICAO Manual of All Weather Operations DOC 9365/AN910.

b. Foreign air carriers previously approved by FAA IAW earlier criteria may continue to apply that earlier criteria. Foreign air carriers seeking approval for operations addressed only by this revision of AC 120-29A (e.g., Category II HUD operations) must meet criteria of this AC, or equivalent criteria acceptable to FAA, for those applicable provisions.

11.1.2. Foreign Air Carrier AFM Provisions. Unless otherwise authorized by FAA, airplanes used by foreign air carriers for Category II within the U.S. should have AFM provisions reflecting an appropriate level of Category II capability as demonstrated to or authorized by FAA, or demonstrated to or authorized by an authority recognized by FAA as having acceptable equivalent Category II airworthiness criteria (e.g., European JAA, Canada MOT, UK CAA).

11.1.3. Foreign Air Carrier Category II Demonstrations.

a. Foreign air carriers meeting FAA criteria, or criteria acceptable to FAA (e.g., European JAA, ICAO Criteria including Doc 9365/AN910), and having more than six months experience in use of Category II operations with the applicable airplane type may be approved for Category II IAW provisions of their own regulatory authority, or IAW standard provisions of part 129 OpSpecs, which ever is the more restrictive.

b. For foreign air carriers not having the above experience, FAA will confer with the authority of the state of the operator and with the operator to jointly determine suitable provisions for a U.S. Category II authorization for that operator. Foreign air carriers not meeting above provisions may be subject to the demonstration requirements of 10.5.2 and 10.9 equivalent to those necessary for U.S. operators, as determined applicable by FAA.

11.2. Issuance of Part 129 Operations Specifications. Foreign air carriers operating to U.S. airports that meet applicable provisions above are approved for Category II through issuance of part 129 OpSpecs. Foreign air carriers intending Category II operations at U.S. designated irregular pre-threshold terrain airports, or airports otherwise requiring special assessments, must successfully complete those assessments prior to use of those facilities.

11.3. Use of Certain Restricted United States Facilities.

a. Foreign air carrier Category I and II operations may be conducted at facilities not having published Category I and II SIAPS, or may be conducted to minima lower than published on part 97 Category I and II SIAPS if they meet criteria equivalent to that required of a U.S. part 121 carrier, and they are approved by FAA, and the operations are acceptable to the authority of the State of the Operator. Similarly, operations may be authorized at other special facilities identified on the FAA Category II/III Status List.

b. For such authorizations the following applies:

(1) The foreign air carrier and the pertinent authority of the State of that Operator must be advised of facility status,

(2) Foreign air carriers must be approved by the State of the Operator's Authority, and

(3) FAA must have evidence from that authority that the foreign air carrier is specifically authorized at that U.S. facility. Foreign air carriers typically use Category II procedures in the U.S. which are available as unrestricted public use procedures.

c. However, FAA may also authorize certain restricted public use procedures and special Category II approach procedures for foreign air carriers. Typically, these procedures require special airborne equipment capability, special training, or non-standard facility and obstacle assessments. These special procedures are identified on the Category II/III Status List and are not usually published as a part-97 Category II SIAP.

d. Foreign air carriers may be eligible to use certain of these procedures if they meet the same special criteria as would apply to a U.S. operator, and if they are approved by their own authority specifically for the use of the procedure. Some procedures may not be eligible for use by foreign air carriers because of other applicable restrictions such as a restriction placed on private facility use. Special or restricted procedures require both FAA authorization and specific authorization from the state of the foreign air carrier's controlling authority for each procedure. This is to ensure that both the foreign air carrier and foreign authority are aware of the special provisions needed, and to ensure equivalent safety in the use of standard ICAO criteria.

e. Each foreign air carrier seeking Category II procedure authorization at a facility not published as a standard and unrestricted Category II SIAP, or at any other ground facilities identified as special or restricted on the FAA Category II/III Status List, and that foreign air carrier's controlling authority must:

(1) Be aware of the restrictions applicable to the procedure (e.g., facility status),

(2) Provide evidence to FAA of the controlling authority's approval of the foreign air carrier for each special procedure requested, and

(3) Must have the applicable limitations and conditions included in that foreign air carrier's part 129 OpSpecs for each procedure to be used.

f. Foreign air carriers shall not normally be authorized for special Category II operations to minima lower than those specified in part 97 Category II SIAPS consistent with ICAO criteria.

12. OPERATOR REPORTING, AND TAKING CORRECTIVE ACTIONS.

12.1. Operator Reporting.

a. The reporting of satisfactory and unsatisfactory Category II airplane performance is a useful tool in establishing and maintaining effective maintenance and operating policy and procedures. Additionally, when maintained over longer periods of time, the report data substantiates a successful program and can identify trends or recurring problems that may not be related to airplane performance. Information obtained from reporting data and its analysis is useful in recommending and issuing appropriate corrective action(s).

b. Accordingly, for a period of at least 1 year after an applicant has been advised that its airplanes and program meet Category II requirements, and reduced minima are authorized, the operator is to provide a monthly summary to the FAA of the following information:

(1) The total number of approaches where the equipment constituting the airborne portion of the Category II system was used to make satisfactory (actual or simulated) approaches to the applicable Category II minima (by airplane type).

(2) The total number of unsatisfactory approaches by airport and airplane registration number with explanations in the following categories - airborne equipment faults, ground facility difficulties, aborts of approaches because of ATS instructions, or other reasons.

c. The operator should also notify the certificate-holding office as soon as possible of any system failures or abnormalities that require flightcrew intervention after passing 100 ft. during operations in weather conditions below Category I minima.

d. Upon request, the CHDO will make this information available to AFS-400 for overall Category II program management, or to assist in assessment of program or facility effectiveness.

NOTE: The reporting burden contained in this AC does not require office of management and budget approval under the provisions of the Paperwork Reduction Act of 1980, according to Section 3502(4)(a).

12.2. Operator Corrective Actions.

a. All Programs.

(1) Operators are expected to take appropriate corrective actions when they determine that airplane, NAVAID, airport difficulties require program or minima adjustment.

(2) At least the following factors should be considered: NAVAID status or performance problems, NOTAM's, airport facility status, air traffic procedure adjustments, lighting or marking system status, airport construction, adverse weather (snow banks, snow removal, icy runways or taxiways, deep snow in glide slope critical areas at foreign airports, etc.), appropriate limitations or restrictions to minima necessary to ensure safe operations.

b. Category II.

(1) In addition to the corrective actions discussed above, for Category II the operations and maintenance manuals should address any corrections needed. Operators are expected to take appropriate corrective actions when they determine that conditions exist which could adversely affect safe Category II operations.

(2) Examples of situations for which an operator may need to take action restricting, limiting, or discontinuing Category II operations include: repeated airplane system difficulties, repeated maintenance write-ups, chronic pilot reports of unacceptable landing performance, applicable service bulletin issuance, AD's, NAVAID status or performance problems, applicable NOTAM's, airport facility status change, air traffic procedure adjustment, lighting, marking, or standby power system status outages, airport construction, obstacle construction, temporary obstacles, natural disasters, adverse weather, snow banks, snow removal, icy runways or taxiways, deep snow in glide slope critical areas, inability to confirm appropriate critical area protection at foreign airports, and other such conditions.

(3) Examples of appropriate corrective action could be an adjustment of Category II programs, procedures, training, modification to airplanes, restriction of minima, limitations on winds, restriction of NAVAID facility use, adjustment of payload, service bulletin incorporation, or other such measures necessary to ensure safe operation.

APPENDIX 1. AIRBORNE SYSTEMS FOR CATEGORY I.

Mandatory terms used in this AC such as "shall" or "must" are used only in the sense of ensuring applicability of these particular methods of compliance when the acceptable means of compliance described herein is used. This AC does not change, add, or delete regulatory requirements or authorize deviations from regulatory requirements.

1. PURPOSE. This appendix contains airworthiness criteria for the approval of aircraft equipment and installations required to conduct an approach in Category I weather minima.

2. GENERAL. Airworthiness approval for the aircraft equipment, system installations and test methods should be based on a consideration of factors such as the intended function of the installed system, its accuracy, reliability, and fail-safe features, as well as the operational concepts contained in the body of this Advisory Circular (AC). In addition to the 20-Series AC's (when applicable), the guidelines and procedures contained herein are considered acceptable methods of determining transport category airplane airworthiness to conduct an approach in Category I weather conditions.

a. The overall assurance of performance and safety of an operation can only be assessed when all elements of the system are considered. This appendix includes a discussion of the non-aircraft elements of a system so that an overall assessment of the operation can be accomplished.

b. References to JAA All Weather Operations Regulations are provided to facilitate the All Weather Operations Harmonization process. A reference to a JAR provision does not necessarily mean that the FAA and JAA requirements are equivalent but that they are related with similar intent. The FAA typically may identify which JAR provisions are acceptable to FAA at the time a type certification basis is established.

2.1. Certification Process. An "impact assessment" should address any new receiver functionality considering:

a. Differences between the current basis of certification and that requested (if applicable).

b. The functionality being added.

c. Credit that can be taken for the existing approval.

2.2. Equipment Approval Criteria. Airborne navigation instrument and/or flight control equipment may be eligible for installation approval as part of an installed system when it is:

a. Found to comply with the requirements of an applicable technical standard order or type certificate, or

b. Found to comply with applicable Federal Aviation Regulations and approved as part of an airplane under a type certificate or supplemental type certificate, or

c. Found to comply with other pertinent specifications adopted by the Administrator; such as, military standards or a foreign government's validation which has been found to be compatible with the intent of the appropriate Federal Aviation Regulations.

2.3. Aircraft Installation Approval (14 CFR Part 25). The following should be considered:

a. Impact on airplane system safety assessments.

b. Radio approval (e.g., antenna positions, range, polar diagrams, coverage, compatibility between receiver and antenna).

c. EMI/EMC testing.

d. Functional integration aspects of the receiver with respect to other systems, controls, warnings, displays.

e. Electrical loading.

f. Flight data recorder requirements.

g. Suitable Aircraft Flight Manual (AFM) provisions.

h. Certification means of compliance for the receiver installation (e.g., specification of ground and/or flight testing, as necessary).

3. INTRODUCTION. This appendix addresses the approach phase of flight. For the purpose of this appendix, the approach phase of flight is defined as the flight segment from the Final Approach Fix (FAF) to the Category I decision altitude/height. This appendix provides criteria which represents an acceptable means of compliance with performance, integrity and availability requirements for low visibility approach. Alternative criteria may be proposed by an applicant. With new emerging technologies, there is a potential for many ways of conducting low visibility approach operations. This appendix does not attempt to provide criteria for each potential combination of airplane and non-airplane elements.

a. Operations using current ILS or MLS ground based facilities and airplane elements are in use, and the certification criteria for approval of these airplane systems are established. Other operations and the use of some new aircraft equipment require Proof of Concept testing to establish appropriate criteria for operational approval and system certification. The need for a Proof of Concept program is identified in this advisory circular with a [PoC] designator. This appendix provides some general guidelines, but not comprehensive criteria, for airplane systems that require a Proof of Concept.

b. The intended flight path may be established in a number of ways. For systems addressed by this appendix, the reference path may be established by a navigation aid (e.g., ILS, MLS).

On-board navigation systems may have various sensor elements by which to determine airplane position. The sensor elements may include ILS, MLS, or inertial information. Each of these sensor elements should be used within appropriate limitations with regard to accuracy, integrity and availability.

Indications of the airplane position with respect to the intended path can be provided to the pilot in a number of ways.

c. The minimum visibility required for safe operations with such systems and backup means will be specified by FAA Flight Standards in the operational authorization.

4. TYPES OF APPROACH OPERATIONS. The airworthiness criteria in this appendix are intended to be consistent with the operational concepts of paragraph 4.3 of the main body of this AC.

ILS and MLS have been characterized by appropriate International Civil Aviation Organization (ICAO) standards.

Landing Systems based on the Global Navigation Satellite System (GNSS) (e.g., Global Positioning System (GPS) Landing System (GLS)) may use interim U.S. criteria, or other FAA-agreed State criteria, or other international standards developed for acceptable combination of space and ground based elements. Acceptable overall aircraft performance may be established based upon the assumption that these services are used and maintained to the specified standards identified, or as specified in the applicable airworthiness approval.

5. TYPES OF APPROACH NAVIGATION SERVICE.

5.1. ILS. The ILS is supported by established international standards for ground station operation. These standards should be used in demonstrating airplane system operation.

The Airplane Flight Manual (AFM) shall indicate that operation is predicated upon the use of an ILS facility with performance and integrity equivalent to, or better than, an ICAO Annex 10 Facility Performance Category I ILS, a U.S. Type I or equivalent.

5.1.1. ILS Flight Path Definition. The required lateral and vertical flight path is inherent in the design of the ILS. Acceptable performance and integrity standards have been established for ILS.

5.1.2. ILS Airplane Position Determination. The airplane lateral and vertical position relative to the desired flight path is accomplished by an ILS receiver which provides deviation from the desired path when in the coverage area.

5.2. MLS. The MLS is supported by established ICAO Annex 10 international standards for ground station operation. These standards should be used in demonstrating airplane system operation.

The Airplane Flight Manual shall indicate that operation is predicated upon the use of an MLS facility with performance and integrity equivalent to, or better than, an ICAO Annex 10 Facility Performance Category I MLS, or equivalent.

5.2.1. MLS Flight Path Definition. The lateral and vertical required flight path is inherent in the design of the MLS. Acceptable performance and integrity standards have been established for MLS.

5.2.2. MLS Airplane Position Determination. The airplane lateral and vertical position relative to the desired flight path is accomplished by an MLS receiver which provides deviation from the desired path when in the coverage area.

5.3. GLS. Currently approved systems are ILS or MLS based. AC 20-138 incorporates airworthiness requirements for SBAS (e.g., WAAS). The application of new technologies and systems will require an overall assessment of the integration of the airplane components with other elements (e.g., new ground based aids, GBAS, advanced radar mapping systems, enhanced vision sensor systems) to ensure that the overall safety of the use of these systems for Category I. This section is included to identify important differences between conventional ILS/MLS based systems and systems that affect GLS criteria development.

5.3.1. GLS Flight Path Definition. Appropriate specification of the required flight path for approach, or approach, landing, and rollout (as applicable), is necessary to assure safety of the operation to the relevant operational minima. The required flight path should be established to provide adequate clearance between the airplane and fixed obstacles on the ground, between airplanes on adjacent approaches, and to ensure that the airplane stays within the confines of the runway.

a. The effect of the navigation reference point on the airplane flight path and wheel-to-threshold crossing height must be addressed.

b. The required flight path is not inherent in the GLS signal structure; therefore, an airplane navigation system must specify a sequence of earth referenced path points, or the airplane must receive information from a ground based system to define the approach, landing, and rollout required path points.

5.3.2. GLS Airplane Position Determination. The safety of an approach operation is, in part, predicated on knowing where the airplane is positioned relative to the required flight path. Navigation satellite systems exist which can provide position information to specified levels of accuracy, integrity, and availability. The accuracy, integrity and availability can be enhanced by additional space and ground based elements. These systems provide certain levels of capability to support present low visibility operations and are planned to have additional future capability.

6. BASIC AIRWORTHINESS REQUIREMENTS. This section identifies airworthiness requirements including those for performance, integrity, and availability which apply to all types of airplane systems, independent of the type of approach and landing or navigation system used. The definitions of performance, integrity, and availability are found in Appendix 1. The basic airworthiness criteria are intended to be independent of the specific implementation in the airplane or the type of Approach system being used. Criteria may be expanded further in later sections of this appendix as it applies to a particular airplane system or architecture.

NOTE: Continuity of Approach Function may involve aircraft systems, ground systems and space based systems. This AC addresses the aircraft part of the system and aircraft criteria will be defined in terms of aircraft system availability to provide quantifiable criteria for airworthiness compliance.

6.1. General Requirements. An applicant shall provide a certification plan which describes how any non-aircraft elements of the Approach System relate to the aircraft system from a performance, integrity and availability perspective. This may be accomplished by reference to ICAO Standards and Recommended Practices (SARPS).

a. The plan for certification shall describe the system concepts and operational philosophy to allow the regulatory authority to determine whether criteria and requirements other than those contained in this appendix are necessary.

b. The Approach system performance should be established considering the environmental and deterministic effects that may reasonably be experienced for the type of operation for which certification and operational approval will be sought.

c. Where reliance is placed on the pilot to detect a failure of engagement of a selected mode (e.g., go-around), mode annunciation shall be clear and unambiguous.

d. The effect of the failures of the navigation facilities must be considered.

e. The effect of the aircraft navigation reference point on the airplane flight path and wheel-to-threshold crossing height shall be assessed.

f. GLS airworthiness approval should be established in accordance with this appendix and in AC 20-138.

6.2. Approach System Accuracy Requirements. The following items are general criteria that apply to the various types of approach operations.

a. Performance shall be demonstrated by flight test, or analysis validated by flight test, using at least 3 different representative facilities for a minimum of 9 total approaches, with a representative range of environmental and system variables which have an effect on overall performance.

b. The performance assessment shall take into account at least the following variables with the variables being applied based upon their expected distribution:

(1) Configurations of the airplane (e.g., flap settings);

(2) Center of gravity;

(3) Landing weight;

(4) Conditions of wind, turbulence, and wind shear;

(5) Characteristics of ground and space based systems and aids (ILS, MLS); and

(6) any other parameter which may affect system performance (e.g., airport altitude, approach path slope, variations in approach speed).

c. The criteria for acceptable approach performance is based upon acquiring and tracking the required flight path to the appropriate minimum altitude for the procedure. The acquisition should be accomplished in a manner compatible with instrument procedure requirements and flightcrew requirements for the type of approach being conducted.

d. An approach guidance system shall not generate command information (e.g., flight director, HUD etc.) which results in flight path control that is oscillatory or requires unusual effort by the pilot to satisfy the performance requirements.

e. An approach control system shall not generate flight path control (e.g., autopilot) with sustained oscillations.

f. The approach system must cause no sustained nuisance oscillations or undue attitude changes or control activity as a result of configuration or power changes or any other disturbance to be expected in normal operation.

6.2.1. ILS. The performance standards for signal alignment and quality contained in ICAO Annex 10 or an equivalent State standard are acceptable standards for operations based on ILS. These standards shall be used in establishing the performance of the operation.

a. Lateral tracking performance from 1000 ft. Height Above Touchdown (HAT) to 200 ft. HAT should be stable without large deviations (i.e., within ±50 microamps deviation) from the indicated course.

b. Vertical tracking performance from 700 ft. HAT to 200 ft. HAT should be stable without large deviations (i.e., within ±75 microamps deviation) from the indicated path.

6.2.2. MLS. The performance standards for signal alignment and quality contained in ICAO Annex 10 or an equivalent State standard are acceptable standards for operations based on MLS. These standards shall be used in establishing the performance of the operation.

a. Lateral tracking performance from 1000 ft. HAT to 200 ft. HAT should be stable without large deviations (i.e., within ±50 microamps deviation) from the indicated course or path.

b. Vertical tracking performance from 700 ft. HAT to 200 ft. HAT should be stable without large deviations (i.e., within ±75 microamps deviation) from the indicated path.

6.3. Approach System Integrity Requirements. The applicant shall provide the certification authority with an overall operational safety assessment plan for the use of systems other than ILS or MLS for "path in space" guidance. This plan shall identify the assumptions and considerations for the non-aircraft elements of the system and how these assumptions and considerations relate to the airplane system certification plan.

a. The onboard components of the landing system, considered separately and in relation to other associated onboard systems, should be designed to comply with Title 14 of the Code of Federal Regulations (14 CFR) part 25, section 25.1309, considering any specific safety related criteria identified in this appendix, or as identified in accordance with the operating rules.

b. The following criteria is provided as advisory material for the application of section 25.1309 to Landing Systems:

6.3.1. ILS. The aircraft system response to loss of ILS guidance signals (localizer and glideslope) shall be established.

6.3.2. MLS. The aircraft system response to loss of MLS guidance signals (elevation and azimuth) shall be established.

6.4. Approach System Availability Requirements. Below 500 ft. on approach, the demonstrated probability of a successful landing should be at least 95% (i.e., no more than 5% of the approaches result in a go-around, due to the combination of failures in the landing system and the incidence of unsatisfactory performance). In addition, a dual or single approach system installation should meet availability requirements consistent with the operational objective of 14 CFR part 121, section 121.349, (as applicable to standard Operations Specifications (OpSpecs)).

6.5. Go-around Requirements. A Go-around may be required following a failure in the Approach System, as required by the flightcrew or by Air Traffic Service (ATS) at any time prior to touchdown.

a. It should be possible to initiate a missed approach at any point during the approach until touchdown on the runway. It should be safe to initiate a missed approach that results in a momentary touchdown on the runway.

b. A go-around should not require unusual pilot skill, alertness, or strength.

c. The proportion of approaches terminating in a go-around below 500 ft (150 m) due to the combination of failures in the landing system and the incidence of unsatisfactory system performance may not be greater than 5 percent.

d. Information should be available to the operator to assure that a safe go-around flight path can be determined.

6.6. Flight Deck Information, Annunciation, and Alerting Requirements. This section identifies information, annunciations and alerting requirements for the flight deck. The controls, indicators and warnings must be designed to minimize flightcrew errors that could create a hazard. Mode and system malfunction indications must be presented in a manner compatible with the procedures and assigned tasks of the flightcrew. The indications must be grouped in a logical and consistent manner and be visible under all expected normal lighting conditions.

6.6.1. Flight Deck Information Requirements. This section identifies requirements for basic situational and guidance information.

a. For manual control of approach flight path, the appropriate flight display(s), whether head-down or head-up, must provide sufficient information, without excessive reference to other cockpit displays, to enable a suitably trained pilot to:

(1) maintain the approach path,

(2) to make the alignment with the runway, and if applicable, safely flare and roll out, or

(3) go-around.

b. Sufficient information should be provided in the flight deck to allow the pilots to monitor the progress and safety of the approach operation, using the information identified above and any additional information necessary to the design of the system.

c. Required in flight performance monitoring capability includes at least the following:

(1) unambiguous identification of the intended path for the approach, and, if applicable, safely flare and roll out, (e.g., ILS/MLS approach identifier/frequency, and selected navigation source), and

(2) indication of the position of the aircraft with respect to the intended path (e.g., raw data localizer and glide path, or equivalent).

6.6.2. Annunciation Requirements. A positive, continuous, and unambiguous indication of the modes actually in operation, as well as those that are armed for engagement, must be provided. In addition, where engagement of a mode is automatic (e.g., localizer and glide path acquisition), clear indication must be given when the mode has been armed by either the action of a flight crewmember or automatically by the system (e.g., a pre-land test - LAND 3).

6.6.3. Alerting. Alerting requirements are intended to address the need for warning, caution, and advisory information for the flightcrew.

6.6.3.1. Warnings. Section 25.1309 requires that information must be provided to alert the crew to unsafe system operating conditions and to enable the crew to take appropriate corrective action. A warning indication must be provided if immediate corrective action is required. The design should account for crew alerting cues, corrective action required, and the capability of detecting faults.

6.6.3.2. Cautions. A caution is required whenever immediate crew awareness is required and timely subsequent crew action may be required. A means shall be provided to advise the flightcrew of failed airplane system elements that affect the decision to continue or discontinue the approach.

For RNP systems, the guidance or control system shall indicate to the flightcrew when the 95 percent horizontal position uncertainty exceeds the RNP.

6.6.3.3. System Status. Appropriate system status and failure annunciations suited to the guidance systems used, navigation sensors used, and any related aircraft systems (e.g., autopilot, flight director, electrical system) should be provided for the operator to determine prior to departure and the flightcrew to determine after departure, the capability of the airplane approach system components to accomplish the intended approach.

a. While en route, the failure of each airplane component affecting the approach capability should be indicated without flightcrew action. The indication should be an advisory (i.e., not a warning or caution, annunciates without flightcrew action, but does not demand immediate flightcrew attention), unless the failure requires a warning or caution for other reasons (e.g., autopilot disconnect warning).

b. A means shall be provided to advise the flightcrew of failed airplane system elements that affect the decision to continue to the destination or divert to an alternate.

c. System Status indications should be identified by names that are different than operational authorization categories (e.g., do not use names such as "CAT I," "CAT II," "CAT III").

6.7. Multiple Landing Systems and Multi-mode Receivers (MMR). International agreements have established a number of landing systems as an acceptable means to provide guidance to support the conduct of an instrument approach. This section identifies unique requirements which relate to airplane systems which provide the capability to conduct approach and landing operations using these multiple landing systems (e.g., ILS, MLS, GLS). These multiple landing systems may be implemented through use of one or more multi-mode navigation receivers (MMR), capable of providing navigation information for ILS, MLS, and GLS or any one or more combinations of these landing sensor systems.

a. ICAO has specified an ILS protection date of at least 2010 to support international approach and take-off operations. In addition, MLS or GLS may be used on a regional basis, until GLS approach, landing, and departure system are in worldwide use. Accordingly, an operator may elect to use ILS, ILS/MLS, ILS/GLS, or ILS/MLS /GLS. If a Multi-mode Receiver (MMR) is used, MMR characteristics should be consistent with applicable related ARINC characteristics for MMR.

b. For aircraft which elect to use MLS, either FAA criteria or JAR-AWO as amended, (e.g., NPA AWO 9), may be used as a consideration in defining the airworthiness requirements for MLS certification.

6.7.1. General Requirements. Where practicable, the flight deck approach procedure should be the same irrespective of the navigation source being used.

a. A means (for example, the current ILS audio idents) should be provided to confirm that the intended approach aid(s) has been correctly selected.

b. During the approach, an indication of a failure in each non-selected airplane system element must be provided to the flightcrew as an indication of system status; it should not produce a caution or warning.

6.7.2. Indications. The following criteria apply to indications in the flight deck for the use of a multi-mode landing system:

The loss of acceptable deviation data shall be indicated on the display. It is acceptable to have a single failure indication for each axis common to all navigation sources.

6.7.3. Annunciations. The following criteria apply to annunciations in the flight deck when using a multi-mode approach system.

a. The navigation source (e.g., ILS, MLS, GLS) selected for the approach shall be positively indicated in the primary field of view at each pilot station;

b. The data designating the approach (e.g., ILS frequency, MLS channel, GLS channel or "path identifier") shall be unambiguously indicated in a position readily accessible and visible to each pilot;

c. A common set of mode ARM and ACTIVE indications (e.g., LOC and GS) is preferred for ILS, MLS and GLS operations;

d. A means should be provided for the crew to determine a failure of the non-selected navigation receiver function, in addition to the selected navigation receiver function. When considering equipment failures, the failure indications should not mislead through incorrect association with the navigation source. For example, it would not be acceptable for the annunciation "ILS FAIL" to be displayed when the selected navigation source is MLS and the failure actually affects the MLS receiver.

6.7.4. Alerting. Flight operations require alternate airports for take-off, en route diversion, and landing. These alternate airports may have different landing systems. Flight operations may be planned, released, and conducted on the basis of using one or more landing systems.

a. The capability of each element of a multi-mode approach and landing system shall be available to the flightcrew to support dispatch of the airplane (e.g., equipment status (BITE)/prediction program).

b. A failure of each element of a multi-mode approach and landing system must be indicated to the flightcrew without pilot action, as an advisory (i.e., not a warning or caution, does not demand immediate flightcrew attention), during en route operation.

c. A failure of the active element of a multi-mode approach and landing system during an approach shall be accompanied by a warning, caution, or advisory (i.e., not a warning or caution, annunciates without flightcrew action, but does not demand immediate flightcrew attention), as appropriate.

d. An indication of a failure in each non-selected element of a multi-mode approach and landing system during an approach may be made available to the flightcrew as an advisory but should not produce a caution or warning.

6.7.5. Multi-mode Receivers (MMR). For MMRs using more than one or more type(s) of landing system, the means of compliance required for certification can be simplified, provided the applicant provides appropriate justification. This section provides guidance for retrofit certifications, for "ILS Look alike" applications, and for certification of ILS installations with either new or modified receivers.

Typical receiver configurations for retrofit applications include:

a. An ILS receiver from a new supplier;

b. A modified ILS receiver from the same supplier (e.g., for purposes of providing improved FM Immunity);

c. A re-packaged receiver from the same supplier (e.g., the ILS partition in an MMR, or the transition from ARINC 700 to 900 series equipment);

d. A stand-alone MLS receiver ("ILS look alike");

e. An MLS partition in an MMR ("ILS look alike");

f. A stand-alone GLS receiver ("ILS look alike"); or

g. A GLS partition in an MMR ("ILS look alike").

6.7.5.1. "ILS Look alike" Definition Applicable to MMR. "ILS Look alike" is defined as the ability of a non-ILS based navigation receiver function to provide operational characteristics and interface functionality to the rest of the aircraft equivalent to that provided by an ILS based receiver function.

6.7.5.2. General Certification Considerations.

6.7.5.2.1. Certification Process. An "impact assessment" should address any new receiver functionality considering:

a. Differences between the current basis of certification and that requested (if applicable).

b. The functionality being added.

c. Credit that can be taken for the existing approval.

6.7.5.2.2. Equipment Approval. TSO/MOPS compliance should be demonstrated where appropriate, including software qualification and receiver environmental qualification to the appropriate levels.

6.7.5.2.3. Aircraft Installation Approval (14 CFR Part 25). The following should be considered:

a. Impact on airplane system safety assessments.

b. Radio approval (e.g., antenna positions, range, polar diagrams, coverage, compatibility between receiver and antenna).

c. EMI/EMC testing.

d. Functional integration aspects of the receiver with respect to other systems, controls, warnings, displays.

e. Electrical loading.

f. Flight data recorder requirements.

g. Suitable Aircraft Flight Manual (AFM) provisions.

h. Certification means of compliance for the receiver installation (e.g., specification of ground and/or flight testing, as necessary).

6.7.5.2.4. Recertification of an ILS function following the Introduction of a New or Modified ILS Navigation Receiver Installation. The certification program should consider the differences between the new configuration and the pre-existing ILS receiver system. An "impact assessment" may be used to establish a basis for certification.

6.7.5.2.4.1. New or Modified ILS Impact Assessment. An impact assessment should consider the following aspects of the new or modified ILS receiver, or receiver function, for equivalence with the existing ILS receiver configuration:

a. hardware design;

b. software design;

c. signal processing and functional performance;

d. failure analysis;

e. receiver function, installation and integration (e.g., with controls, indicators and warnings).

The impact assessment should also identify any additional considerations such as:

a. Future functionality provisions which have no impact on system operation;

b. Shared resources to support future functionality.

Based upon the assumption that the ILS receiver, or receiver function, can be shown to be equivalent to the current ILS configuration, the applicant may propose that the new installation be treated as a new ILS receiver for installation on a given airplane type.

6.7.5.2.4.2. New or Modified ILS Failure Analysis. The failure characteristics of the new or modified installation should be reviewed, equivalent to systems using ILS data, to ensure that the failure characteristics are compatible with and do not invalidate any original or previous safety assessments.

6.7.5.2.4.3. New or Modified ILS Autoland or HUD Guidance Landing Function Flight Testing (if necessary). For systems intended to provide Autoland or HUD guidance landing function using a new ILS, MLS, GLS, or combined MMR receiver, a flight test program of typically a minimum of eight approaches terminating in a successful (automatic or HUD) landing and rollout (if applicable) using the flight control/guidance system, including a minimum of two ILS facilities should be completed. Approaches should include captures from both sides of the final approach course, at angles and distances representative of typical instrument approach procedures, and, if applicable, from below and above the glideslope.

The approach and landing performance (flight path deviation, touchdown data etc.) as appropriate, should be shown to be equivalent to that achieved in the original ILS certification. Recorded flight test data may be required to support equivalency demonstration.

A demonstration of take-off guidance performance should be included where applicable.

6.7.5.2.4.4. New or Modified ILS Documentation. The following documentation should be provided for certification:

a. An Impact Assessment including effects on System Safety Assessments.

b. A Flight test report, if applicable.

c. Revisions to the Flight Manual where appropriate.

6.7.5.2.5. Recertification Following the Introduction of an MLS or GLS Navigation Receiver Installation.

6.7.5.2.5.1. MLS or GLS Introduction Impact Assessment. An MLS or GLS receiver or receiver function, can be certificated with an "impact assessment" similar to that required for the recertification of a new or modified ILS receiver, provided that the unit(s) has been shown to have satisfactory "ILS Look alike" characteristics. The "impact assessment" should assess equivalent aspects of the MLS or GLS receiver or receiver function to those for the existing ILS receiver configuration.

Based upon the assumption that the MLS or GLS receiver or receiver function, can be shown to have "ILS look alike" characteristics, the applicant may propose that the new installation be treated as a new ILS receiver for approval on a particular airplane type.

6.7.5.2.5.2. MLS or GLS Statistical Performance Assessment. If the flight control/guidance system control algorithms are unchanged or effects of any changes are fully accounted for (e.g., navigation reference point), the statistical performance assessment of a currently certificated automatic landing system or Head-up Display landing or take-off system should typically not have to be re-assessed for the addition of MLS or GLS functionality. This equivalence is based on the assumption that the MLS or GLS receiver, or the MLS or GLS partition of an MMR, can be shown to have satisfactory "ILS Look alike" characteristics.

6.7.5.2.5.3. MLS or GLS Antenna or Navigation Reference Point Location. The implication of differences in position of the MLS or GLS and ILS aircraft antennas or Navigation Reference Point should be assessed considering:

a. Wheel-to-threshold crossing height;

b. Lateral and vertical antenna position or navigation reference point position effects on flight guidance system performance (including any alignment, flare, or rollout maneuvers).

6.7.5.2.5.4. MLS or GLS Introduction Flight Testing (as necessary). For an installation of MLS or GLS which can be treated as a new ILS receiver, a flight test program of typically a minimum of 10-15 approaches terminating in a landing and rollout (if applicable) using the flight control/guidance system, including a minimum of two MLS or GLS facilities for each system to be authorized should be completed. The approaches should include captures from both sides of the final approach course using representative angles and distances, should include captures from below and above the glideslope if applicable, and should include representative wind conditions where antenna or navigation reference point positions may impact performance.

The approach and landing performance (flight path deviation, touchdown data etc.) as appropriate, should be shown to be equivalent to that achieved in the original ILS certification. Recorded flight test data may be required to support equivalency.

A demonstration of take-off guidance performance should be included where applicable.

6.7.5.2.5.5. MLS or GLS Introduction Documentation. The following documentation should be provided for certification of MLS or GLS:

a. An Impact Assessment including effects on System Safety Assessments.

b. A Flight test report, if applicable.

c. Revisions to the Flight Manual where appropriate.

6.8. Steep Angle Approaches. The following considerations should be considered before AFM provisions are incorporated for steep angle approaches:

a. The descent gradient range to be demonstrated.

b. Suitable "touchdown zone" size considerations, if not standard.

c. Adequate descent gradient abuse recovery.

d. Adequate speed abuse recovery.

e. Engine-failure continuation safety.

f. Engine-failure balked or rejected landing safety.

g. Adverse tailwind gradients on approach.

h. Adverse tailwind component limits at touchdown.

i. De-ice and Anti-ice protection considerations.

j. Suitability of cockpit visibility during approach and flare.

k. Suitability of climb gradient achievable while in the steep angle approach configuration, as necessary.

l. Suitability of descent, flare, and touchdown sink rates.

m. Provision for drag device (e.g., spoiler or auto-feather) failure.

n. Suitability of auto-feather response and time delays, as applicable.

o. Flight guidance system compatibility with steep angle approach paths to be flown.

p. Antenna function for navigation and communication performance are satisfactory.

q. Flight guidance display systems are satisfactory.

r. Suitable procedures are provided for approach, rejected landing, and missed approach for all-engine and engine-inoperative cases, and engine failure is addressed at any time until touchdown, during rollout, or after a go around.

s. Any adverse deck angle effects or landing gear geometry effects.

7. APPROACH SYSTEM EVALUATION. An evaluation should be conducted to verify that the pertinent systems as installed in the airplane meet the airworthiness requirements of section 6 of this appendix. The evaluation should include verification of approach system performance requirements and a safety assessment for verification of the integrity and availability requirements. Engine failure cases and other selected failure conditions identified by the safety assessment should be demonstrated by simulator and/or flight tests.

An applicant shall provide a certification plan(s) that describes:

a. The means proposed to show compliance with the requirements of section 6 of this appendix, with particular attention to methods that differ significantly from those described in this appendix.

b. How any non-airplane elements of the Approach System relate to the airplane system from a performance, integrity and availability perspective (e.g., appropriate reference to ICAO Annex or U.S. Standard).

c. The system concepts and operational philosophy to allow the regulatory authority to determine whether criteria and requirements in excess of that contained in this appendix are necessary.

7.1. Performance Evaluation. The performance assessment can be accomplished "in flight," or credited from similar installations as follows:

a. Performance and analysis shall be demonstrated by flight test using at least 3 different representative facilities for a minimum of 9 total approaches, with a representative range of environmental and system variables which have an effect on overall performance.

b. Acceptable performance may be established as a by-product of, or in conjunction with, a more restrictive performance demonstration(s) (e.g., Basic type certification, or as a consequence of successfully meeting Category II/III criteria);

(1) As a dedicated qualitative "in flight" demonstration of acceptable performance; or

(2) By establishing similarity with other mature and acceptably performing system installations. For this provision, "in-flight" demonstration is not necessary, but a functional ground check, bench test, or other equipment check is typically appropriate This provision is typically used in the instance of installation of a new model of ILS, VOR, ADF, or DME receiver.

7.2. Safety Assessment. Except as required by any specific safety related criteria identified in this appendix, or by the operating rules, a safety assessment of the Approach system, considered separately and in conjunction with other systems, shall be conducted to show compliance with section 25.1309.

8. AIRBORNE SYSTEM REQUIREMENTS. This section identifies criteria applicable to specific aircraft system architecture selected to conduct the operation. This criteria is developed from operational considerations, approach system considerations, airplane system considerations and the general operational philosophy contained in the body of this AC.

8.1. General. Various airplane systems are expected to comply with the basic performance, integrity, and availability requirements as identified in paragraph 6 of this appendix.

8.2. Autopilot. Criteria applicable to Autopilot systems is as specified by section 25.1329.

8.3. Head-down Guidance. Criteria applicable to Head-down Guidance systems are specified in the pertinent parts of paragraphs 4 and 5 of this appendix.

8.4. Head-up Guidance. The following criteria is applicable to Head-up Guidance systems:

a. The workload associated with use of the HUD should be considered in showing compliance with section 25.1523.

b. The HUD display medium must not significantly obscure the pilot’s view through the cockpit window.

c. Control of Approach Flight Path - the HUD must provide sufficient guidance information, without excessive reference to other cockpit displays, to enable a suitably trained pilot to:

(1) maintain the approach path,

(2) go-around.

d. The pilot should be able to align with the runway without the HUD adversely affecting the pilot task. If command information is provided for the flare and landing, it must not be misleading and should be consistent with the characteristics of normal manual maneuvers.

e. If only one HUD is installed, it should be installed at the pilot-in-command crew station.

f. The HUD guidance must not require exceptional piloting skill to achieve the required performance.

g. The HUD system performance and alerting should be consistent with the intended operational use for duties and procedures of the pilot flying (PF) and pilot not flying (PNF) (see sections 5.6 and 5.8 of the main body of this AC).

h. If the autopilot is used to control the flight path of the airplane to intercept and establish the approach path, the point during the approach at which the transition from automatic to manual flight takes place shall be identified and used for the performance demonstration.

i. Any transition from autopilot to HUD guidance must not require exceptional piloting skill, alertness, strength or excessive workload.

8.5. Hybrid HUD/Autoland Systems [PoC]. The following criteria is applicable to Hybrid systems:

a. If a HUD is used to monitor an autoflight system, it should be shown to be compatible with the autoflight system and permit a pilot to detect unsuitable autopilot performance.

b. Other hybrid systems (e.g., including EVS) require a proof of concept **[PoC]** evaluation to establish suitable criteria.

8.6. Autothrottle. If autothrottle capability is installed, the applicant should identify any necessary modes, conditions, procedures, or constraints that apply to its use. Use of the autothrottle should not cause unacceptable performance of any autopilot modes intended for use, and any autopilot mode intended for use with autothrottle should not cause unacceptable autothrottle performance. The autothrottle should expeditiously capture any commanded speed adjustments, acceptably maintain speed, and not cause any hazardous conditions with normal use, or for any probable failure modes, considering pilot intervention using normal piloting skills.

9. AIRPLANE FLIGHT MANUAL (AFM). The AFM should contain the following information:

a. Any conditions or constraints on approach performance with regard to airport conditions (e.g., elevation, ambient temperature, approach path slope, runway slope and ground profile under the approach path);

b. The criteria used for the demonstration of the system, acceptable normal and non-normal procedures, the demonstrated configurations and types of facilities used, and any constraints or limitations necessary for safe operation;

c. The type of navigation facilities used as a basis for certification. This should not be taken as a limitation on the use of other facilities. The AFM may contain a statement regarding the type of facilities or condition known to be unacceptable for use;

d. Information should be provided to the flightcrew regarding atmospheric conditions under which the system was demonstrated (e.g., headwind, crosswind, tailwind etc.). The AFM should contain a statement that "Credit may not be predicated on the use of <type of system> if conditions exceed … (those for which the system received airworthiness approval)";

e. Any necessary performance, procedure or configuration data to permit an operator to determine climb gradient and transition distances for safe obstacle clearance during a missed approach, balked landing, or rejected landing. NOTE: This information need not be specifically included in the AFM if it is available to the operator using some other method acceptable to the operator and manufacturer (e.g., FCOM, supplementary performance information, separate AFM appendix);

Data may be based on corresponding take-off performance and obstacle assessment data if appropriate accommodation of configuration change and transition distance can be accounted for. Otherwise, additional information on data that may be useful to an operator for determination of engine-inoperative missed performance, maximum allowable weight, or obstacle assessments is discussed in the main body of this advisory circular in Section 4.3.1.8.

NOTE 1: The AFM limitation section should not specify DA(H) or RVR limitations.

NOTE 2: Section 2 of AC 25.1581-1 discusses AFM contents. The approval status referenced in 2 b (9) (vii) for Category I, II, or III of that AC should be noted in the Normal Procedures Section of the AFM, in accordance with the above provisions. 9. Airplane Flight Manual.

APPENDIX 2. AIRBORNE SYSTEMS FOR CATEGORY II.

Mandatory terms used in this Advisory Circular (AC) such as "shall" or "must" are used only in the sense of ensuring applicability of these particular methods of compliance when the acceptable means of compliance described herein are used. This AC does not change, add, or delete regulatory requirements or authorize deviations from regulatory requirements.

1. PURPOSE. This appendix contains airworthiness criteria for the approval of aircraft equipment and installations required to conduct an approach in Category II weather minima.

2. INTRODUCTION. This appendix addresses the approach phase of flight. For the purpose of this appendix, the approach phase of flight is defined as the flight segment from the Final Approach Fix (FAF) to the Category II DA(H). This appendix provides criteria which represents an acceptable means of compliance with performance, integrity and availability requirements for low visibility approach. An applicant may propose alternative criteria. With new emerging technologies, there is a potential for many ways of conducting low visibility approach operations. This appendix does not attempt to provide criteria for each potential combination of airplane and non-airplane elements.

Operations using current Instrument Landing System (ILS) or Microwave Landing System (MLS) ground based facilities and airplane elements are in use, and the certification criteria for approval of these airplane systems are established. Other operations, using non-ground based facilities or evolving ground facilities and the use of some new aircraft equipment require Proof of Concept testing to establish appropriate criteria for operational approval and system certification. The need for a Proof of Concept program is identified in this advisory circular with a **[PoC]** designator. This appendix provides some general guidelines, but not comprehensive criteria for airplane systems that require a Proof of Concept.

Definitive lateral and vertical flight paths are required to conduct an approach in low weather minima conditions. The flight paths should lead to a touchdown in the landing zone and airplane alignment with the axis that passes down the centerline of the runway. Means should be provided on-board the airplane to acquire and track the required flight paths.

The intended flight path may be established in a number of ways. For systems addressed by this appendix, the reference path may be established by a navigation aid (e.g., ILS, MLS). Other methods may be acceptable if shown feasible by a Proof of Concept **[PoC]**. Methods requiring **PoC** include, but are not limited to:

- the use of ground surveyed waypoints, either stored in an on-board data base or provided by data link to the airplane, with path definition by the airborne system

- sensing of the runway environment (e.g., surface, lighting and/or markings) with a vision enhancement system

On-board navigation systems may have various sensor elements by which to determine airplane position. The sensor elements may include ILS, MLS, GLS, or inertial information. Each of these sensor elements should be used within appropriate limitations with regard to accuracy, integrity, and availability.

Indications of the airplane position with respect to the intended path can be provided to the pilot in a number of ways.

- deviation displays with reference to navigation source (e.g., ILS receiver, MLS receiver)

- on-board navigation system computations with corresponding displays of position and reference path **[PoC]**

- by a vision enhancement system **[PoC]**

The minimum visibility required for safe operations with such systems and backup means will be specified by FAA Flight Standards in the operational authorization.

3. GENERAL. The airworthiness approval for the aircraft should be based on a consideration of factors such as the intended function of the installed system, its accuracy, reliability, and fail-safe features, as well as the operational concepts contained in the body of this AC. In addition to the 20 series AC's (when applicable),the guidelines and procedures contained herein are considered acceptable methods of determining transport category airplane airworthiness to conduct an approach in Category II weather conditions.

a. The overall assurance of performance and safety of an operation can only be assessed when all elements of the system are considered. This appendix includes a discussion of the non-aircraft elements of a system so that an overall assessment of the operation can be accomplished.

b. References to Joint Airworthiness Authority (JAA) All Weather Operations Regulations (JAR) are provided to facilitate the All Weather Operations Harmonization process. A reference to a JAR provision does not necessarily mean that the FAA and JAA requirements are equivalent but that they are related with similar intent. The FAA may typically identify which JAR provisions are acceptable to FAA at the time a type certification basis is established.

3.1. Certification Process. An "impact assessment" should address any new receiver functionality considering:

a. Differences between the current basis of certification and that requested (if applicable).

b. The functionality being added.

c. Credit that can be taken for existing approval.

3.2. Equipment Approval Criteria. Airborne navigation instrument and/or flight control equipment may be eligible for installation approval as part of an installed system when it is:

a. Found to comply with the requirements of an applicable technical standard order or type certificate, or

b. Found to comply with applicable Federal Aviation Regulations and approved as part of an airplane under a type certificate or supplemental type certificate, or

c. Found to comply with other pertinent specifications adopted by the Administrator; such as, military standards or a foreign government's validation which has been found to be compatible with the intent of the appropriate Federal Aviation Regulations.

3.3. Aircraft Installation Approval (14 CFR Part 25). The following should be considered:

a. Impact on airplane system safety assessments.

b. Radio approval (e.g. antenna positions, range, polar diagrams, coverage, compatibility between receiver and antenna).

c. EMI/EMC testing.

d. Functional integration aspects of the receiver with respect to other systems, controls, warnings, displays.

e. Electrical loading.

f. Flight data recorder requirements.

g. Suitable Aircraft Flight Manual (AFM) provisions.

h. Certification means of compliance for the receiver installation (e.g., specification of ground and/or flight testing, as necessary).

4. TYPES OF APPROACH OPERATIONS. The airworthiness criteria in this appendix are intended to be consistent with the operational concepts of Section 4.3 of the main body of this AC.

4.1. Operations based on xLS. ILS and MLS have been characterized by appropriate international (ICAO) standards.

Landing Systems based on GNSS Landing System (GLS) may use interim U.S. criteria, or other FAA agreed State criteria, or other international standards developed for acceptable combination of space and ground based elements. Acceptable overall aircraft performance may be established based upon the assumption that these services are used and maintained to the specified standards identified, or as specified in the applicable airworthiness approval.

4.2. Operations based on Required Navigation Performance (RNP). The airworthiness criteria in this appendix and RTCA/DO-236 will support the operational concept for RNP as described in Section 4.5 in the main body of this AC.

5. TYPES OF APPROACH NAVIGATION SERVICE.

5.1. ILS. The ILS is supported by established international standards for ground station operation. These standards should be used in demonstrating airplane system operation.

The airplane system response during a switchover from an active localizer transmitter to a backup transmitter shall be established.

The Airplane Flight Manual shall indicate that operation is predicated upon the use of an ILS facility with performance and integrity equivalent to, or better than, an International Civil Aviation Organization (ICAO) Annex 10 Facility Performance Category II ILS, an U.S. Type II or equivalent.

5.1.1. ILS Flight Path Definition. The required lateral and vertical flight path is inherent in the design of the ILS. Acceptable performance and integrity standards have been established for ILS.

5.1.2. ILS Airplane Position Determination. The airplane lateral and vertical position relative to the desired flight path is accomplished by an ILS receiver that provides deviation from the desired path when in the coverage area.

5.2. MLS. The MLS is supported by established ICAO Annex 10 international standards for ground station operation. These standards should be used in demonstrating airplane system operation.

The airplane system response during a switchover from an active azimuth transmitter to a backup transmitter shall be established.

The Airplane Flight Manual shall indicate that operation is predicated upon the use of an MLS facility with performance and integrity equivalent to, or better than, an ICAO Annex 10 Facility Performance Category II MLS, or equivalent.

5.2.1. MLS Flight Path Definition. The lateral required flight path is inherent in the design of the MLS. Acceptable performance and integrity standards have been established for MLS.

5.2.2. MLS Airplane Position Determination. The airplane lateral position relative to the desired flight path is accomplished by an airplane MLS receiver that provides deviation from the desired path when in the coverage area.

6. BASIC AIRWORTHINESS REQUIREMENTS. This section identifies airworthiness requirements, including those for performance, integrity, and availability, that apply to all types of airplane systems, independent of the type of approach and landing or navigation system used. The definitions of performance, integrity, and availability are found in Appendix 1. The basic airworthiness criteria are intended to be independent of the specific implementation in the airplane or the type of Approach system being used. Criteria may be expanded further in later sections of this appendix as it applies to a particular airplane system or architecture.

NOTE: Continuity of Approach Function may involve aircraft systems, ground systems and space based systems. This AC addresses the aircraft part of the system, and aircraft criteria will be defined in terms of the aircraft system to provide quantifiable criteria for airworthiness compliance.

6.1. General Requirements. An applicant shall provide a certification plan which describes how any non-aircraft elements of the Approach System relate to the aircraft system from a performance, integrity and availability perspective. This may be accomplished by reference to ICAO Standards and Recommended Practices (SARPS).

a. The plan for certification shall describe the system concepts and operational philosophy to allow the regulatory authority to determine whether criteria and requirements other than those contained in this appendix are necessary.

b. The Approach system performance should be established considering the environmental and deterministic effects that may reasonably be experienced for the type of operation for which certification and operational approval will be sought.

c. Where reliance is placed on the pilot to detect a failure of engagement of a selected mode (e.g., Go-around), mode annunciation shall be clear and unambiguous.

d. The effect of the failures of the navigation facilities must be considered.

e. The effect of the aircraft navigation reference point on the airplane flight path and wheel to threshold crossing height shall be assessed.

f. The use of manual control or the transition from automatic control to manual control must not require exceptional piloting skill, alertness or strength.

g. GLS airworthiness approval should be established in accordance with this appendix and in AC 20-138.

6.2. Approach System Accuracy Requirements. The following items are general criteria that apply to the various types of approach operation.

a. Performance shall be demonstrated by flight test, or analysis validated by flight test, using at least 3 different representative facilities for a minimum of 20 total approaches, with a representative range of environmental and system variables which have an effect on overall performance.

b. The performance assessment shall take into account at least the following variables with the variables being applied based upon their expected distribution:

(1) Configurations of the airplane (e.g., flap settings);

(2) Center of gravity;

(3) Landing weight;

(4) Conditions of wind, turbulence and wind shear;

(5) Characteristics of ground and space based systems and aids (ILS, MLS); and

(6) any other parameter which may affect system performance (e.g., airport altitude, approach path slope, variations in approach speed).

c. The criteria for acceptable approach performance is based upon acquiring and tracking the required flight path to the appropriate minimum altitude for the procedure. The acquisition should be accomplished in a manner compatible with instrument procedure requirements and flightcrew requirements for the type of approach being conducted.

d. An approach guidance system shall not generate command information (e.g. flight director, HUD etc.) which results in flight path control that is oscillatory or requires unusual effort by the pilot to satisfy the performance requirements.

e. An approach control system shall not generate flight path control (e.g., autopilot) with sustained oscillations.

f. The approach system must cause no sustained nuisance oscillations or undue attitude changes or control activity as a result of configuration or power changes or any other disturbance to be expected in normal operation.

6.2.1. ILS. The performance standards for signal alignment and quality contained in ICAO Annex 10, or an equivalent State standard, are acceptable standards for operations based on ILS. These standards shall be used in establishing the performance of the operation.

a. Lateral tracking performance from 300 ft. HAT to 100 ft. HAT should be stable without large deviations (i.e., within ±25 microamps deviation) from the indicated course, for 95% of the time per approach.

b. Vertical tracking performance from 300 ft. HAT to 100 ft. HAT should be stable without large deviations (i.e., within ±35 microamps deviation) from the indicated path or ±12 ft, whichever is greater, for 95% of the time per approach.

c. The Continuous Method and the Pass/Fail methods found in JAR ACJ AWO 231 may be used in lieu of the 95% of the time per approach and the minimum number of 20 approaches stated above.

6.2.2. MLS. The performance standards for signal alignment and quality contained in ICAO Annex 10 or an equivalent State standard are acceptable standards for operations based on MLS. These standards shall be used in establishing the performance of the operation.

a. Lateral tracking performance from 300 ft. HAT to 100 ft. HAT should be stable without large deviations (i.e., within ±25 microamps deviation) from the indicated course, for 95% of the time per approach.

b. Vertical tracking performance from 300 ft. HAT to 100 ft. HAT should be stable without large deviations (i.e., within ±35 microamps deviation) from the indicated path or ±12 ft, whichever is greater, for 95% of the time per approach.

c. The Continuous Method and the Pass/Fail methods found in JAR ACJ AWO 231 may be used in lieu of the 95% of the time per approach and the minimum number of 20 approaches stated above.

6.3. Approach System Integrity Requirements. The applicant shall provide the certification authority with an overall operational safety assessment plan for the use of systems other than ILS or MLS for "path in space" guidance. This plan shall identify the assumptions and considerations for the non-aircraft elements of the system and how these assumptions and considerations relate to the airplane system certification plan.

a. The onboard components of the landing system, considered separately and in relation to other associated onboard systems, should be designed to comply with Title 14 of the Code of Federal Regulations (14 CFR) part 25, section 25.1309, considering any specific safety related criteria identified in this appendix, or as identified in accordance with the operating rules.

b. The following criteria is provided as advisory material for the application of section 25.1309 to Landing Systems:

6.3.1. ILS. The aircraft system response to loss of ILS guidance signals (localizer and glideslope) shall be established.

The aircraft system response during a switchover from an active localizer or glideslope transmitter to a backup transmitter shall be established.

6.3.2. MLS. The aircraft system response to loss of MLS guidance signals (elevation and azimuth) shall be established.

The aircraft system response during a switchover from an active elevation or azimuth transmitter to a backup transmitter shall be established.

6.4. Approach System Availability Requirements. Below 500 ft. on approach, the demonstrated probability of a successful landing should be at least 95% (i.e., no more than 5% of the approaches result in a go-around, due to the combination of failures in the landing system and the incidence of unsatisfactory performance). In addition, a dual or single approach system installation must meet the availability requirements of 14 CFR part 121, section 121.349, OpSpecs.

6.5. Go-around Requirements. A go-around may be required following a failure in the Approach System, as required by the flightcrew or by Air Traffic Service (ATS) at any time prior to touchdown.

a. It should be possible to initiate a missed approach at any point during the approach until touchdown on the runway. It should be safe to initiate a missed approach that results in a momentary touchdown on the runway.

b. A go-around should not require unusual pilot skill, alertness, or strength.

c. The proportion of approaches terminating in a go-around below 500 ft (150 m), due to the combination of failures in the landing system and the incidence of unsatisfactory system performance, may not be greater than 5%.

d. Information should be available to the operator to assure that a safe go-around flight path can be determined.

NOTE: Refer to section 5.14 in the main body of this AC for additional information for go-around capability.

6.6. Flight Deck Information, Annunciation, and Alerting Requirements. This section identifies information, annunciations, and alerting requirements for the flight deck.

The controls, indicators, and warnings must be designed to minimize crew errors that could create a hazard. Mode and system malfunction indications must be presented in a manner compatible with the procedures and assigned tasks of the flightcrew. The indications must be grouped in a logical and consistent manner and be visible under all expected normal lighting conditions.

6.6.1. Flight Deck Information Requirements. This section identifies requirements for basic situational and guidance information.

a. For manual control of approach flight path, the appropriate flight display(s), whether head-down or head-up, must provide sufficient information, without excessive reference to other cockpit displays, to enable a suitably trained pilot to:

(1) maintain the approach path,

(2) to make the alignment with the runway, and if applicable, safely flare and roll out, or

(3) go-around.

b. Sufficient information should be provided in the flight deck to allow the pilots to monitor the progress and safety of the approach operation, using the information identified above and any additional information necessary to the design of the system.

c. Required in flight performance monitoring capability includes at least the following:

(1) unambiguous identification of the intended path for the approach, and, if applicable, safely flare and roll out, (e.g., ILS/MLS approach identifier/frequency, and selected navigation source), and

(2) indication of the position of the aircraft with respect to the intended path (e.g., situation information localizer and glide path, or equivalent).

6.6.2. Annunciation Requirements. A positive, continuous, and unambiguous indication must be provided of the modes actually in operation, as well as those that are armed for engagement. In addition, where engagement of a mode is automatic (e.g., localizer and glide path acquisition), clear indication must be given when the mode has been armed by either action of a member of the flightcrew, or automatically by the system (e.g., a pre-land test - LAND 3).

6.6.3. Alerting. Alerting requirements are intended to address the need for warning, caution, and advisory information for the flightcrew.

6.6.3.1. Warnings. Section 25.1309 requires that information must be provided to alert the crew to unsafe system operating conditions and to enable the crew to take appropriate corrective action. A warning indication must be provided if immediate corrective action is required. The design should account for crew alerting cues, corrective action required, and the capability of detecting faults.

6.6.3.2. Cautions. A caution is required whenever immediate crew awareness is required and timely subsequent crew action may be required. A means shall be provided to advise the flightcrew of failed airplane system elements that affect the decision to continue or discontinue the approach.

Deviation alerting. The FAA does not require excessive deviation alerting, but will approve systems that meet appropriate criteria. If a method is provided to detect excessive deviation of the airplane, laterally and vertically during approach to touchdown, and laterally after touchdown, then it should not require excessive workload or undue attention. This provision does not require a specified deviation alerting method or annunciation, but may be addressed by parameters displayed on the Attitude Direction Indicator (ADI), Electronic Attitude Indicator (EADI), Head-up Display (HUD), or PFD. When a dedicated deviation alerting is provided, its use must not cause excessive nuisance alerts.

For systems demonstrated to meet criteria for Category II, compliance with the following criteria, from JAA/AWO 236, is an acceptable means of compliance, but is not a required means of compliance:

a. For systems meeting the AWO 236 criteria, excess-deviation alerts should operate when the deviation from the ILS or MLS glide path or localizer centerline exceeds a value from which a safe landing can be made from offset positions equivalent to the excess-deviation alert, without exceptional piloting skill and with the visual references available in these conditions.

b. For systems meeting the AWO 236 criteria, excess-deviation alerts should be set to operate with a delay of not more than one (1) second from the time that the deviation thresholds are exceeded.

c. For systems meeting the AWO 236 criteria, excess-deviation alerts should be active at least from 300 ft. HAT (90 m) to the decision height, but the glide path alert should not be active below 100 ft. HAT (30 m).

6.6.3.3. System Status. Appropriate system status and failure annunciations suited to the guidance systems used, navigation sensors used, and any related aircraft systems (e.g., autopilot, flight director, electrical system) should be provided for the operator to determine prior to departure and the flightcrew to determine after departure, the capability of the airplane approach system components to accomplish the intended approach.

a. While en route, the failure of each airplane component affecting the approach capability should be indicated without flightcrew action. The indication should be an advisory (i.e., not a warning or caution, annunciates without flightcrew action, but does not demand immediate flightcrew attention), unless the failure requires a warning or caution for other reasons (e.g., autopilot disconnect warning).

b. A means shall be provided to advise the flightcrew of failed airplane system elements that affect the decision to continue to the destination or divert to an alternate.

c. System Status indications should be identified by names that are different than operational authorization categories (e.g., do not use names such as "CAT I," "CAT II," "CAT III").

6.7. Multiple Landing Systems and Multi-mode Receivers (MMR) for Category II. International agreements have established a number of landing systems as an acceptable means to provide guidance to support the conduct of an instrument approach. This section identifies unique requirements which relate to airplane systems which provide the capability to conduct approach and landing operations using these multiple landing systems (e.g., ILS, MLS, GLS). Provisions equivalent to those listed in Appendix 2 Section 6.7, except as appropriate for systems applicable to Category II, may be applied.

6.7.1. General Requirements. Where practicable, the flight deck approach procedure should be the same irrespective of the navigation source being used.

A means (for example the current ILS audio idents) should be provided to confirm that the intended approach aid(s) has been correctly selected.

During the approach, an indication of a failure in each non-selected airplane system element must be provided to the flightcrew as an indication of system status; it should not produce a caution or warning.

6.7.2. Indications. The following criteria apply to indications in the flight deck for the use of a multi-mode landing system:

The loss of acceptable deviation data shall be indicated on the display. It is acceptable to have a single failure indication for each axis common to all navigation sources.

6.7.3. Annunciations. The following criteria applies to annunciations in the flight deck when using a multi-mode approach system:

The navigation source (e.g., ILS, MLS, GLS) selected for the approach shall be positively indicated in the primary field of view at each pilot station,

The data designating the approach (e.g., ILS frequency, MLS channel, GLS channel or "path identifier") shall be unambiguously indicated in a position readily accessible and visible to each pilot,

A common set of mode ARM and ACTIVE indications (e.g., LOC and GS) is preferred for ILS, MLS and GLS operations, and

A means should be provided for the crew to determine a failure of the non-selected navigation receiver function, in addition to the selected navigation receiver function. When considering equipment failures, the failure indications should not mislead through incorrect association with navigation source. For example, it would not be acceptable for the annunciation "ILS FAIL" to be displayed when the selected navigation source is MLS and the failure actually affects the MLS receiver.

6.7.4. Alerting. Flight operations require alternate airports for take-off, en route diversion, and landing. These alternate airports may have different landing systems. Flight operations may be planned, released, and conducted on the basis of using one or more landing systems.

a. The capability of each element of a multi-mode approach and landing system shall be available to the flightcrew to support dispatch of the airplane (e.g., equipment status (BITE)/prediction program).

b. A failure of each element of a multi-mode approach and landing system must be indicated to the flightcrew without pilot action, as an advisory (i.e., not a warning or caution, does not demand immediate flightcrew attention), during en route operation.

c. A failure of the active element of a multi-mode approach and landing system during an approach shall be accompanied by a warning, caution, or advisory (i.e., not a warning or caution, annunciates without flightcrew action, but does not demand immediate flightcrew attention), as appropriate.

d. An indication of a failure in each non-selected element of a multi-mode approach and landing system during an approach may be made available to the flightcrew as an advisory but should not produce a caution or warning.

6.7.5. Multi-mode Receivers (MMR) used for Systems for Category II. For MMRs used for systems for Category II, using more than one type of landing system, the means of compliance required for certification can be simplified, provided the applicant provides appropriate justification. This section provides guidance for retrofit certifications, for "ILS Look alike" applications, and for certification of ILS installations with either new or modified receivers. Equivalent provisions as to those described in Appendix 2, paragraph 6.7.5 , except as applicable to criteria for Category II, may be applied.

7. APPROACH SYSTEM EVALUATION. An evaluation should be conducted to verify that the pertinent systems as installed in the airplane meet the airworthiness requirements of section 6 of this appendix. The evaluation should include verification of approach system performance requirements and a safety assessment for verification of the integrity and availability requirements. Engine failure cases and other selected failure conditions identified by the safety assessment should be demonstrated by simulator and/or flight tests (refer to section 5.17 in the main body of this AC for information relating to engine inoperative category II capability).

An applicant shall provide a certification plan(s) that describes:

a. The means proposed to show compliance with the requirements of section 6 of this appendix, with particular attention to methods that differ significantly from those described in this appendix.

b. How any non-airplane elements of the Approach System relate to the airplane system from a performance, integrity and availability perspective (e.g., appropriate reference to ICAO Annex or U.S. Standard).

c. The system concepts and operational philosophy to allow the regulatory authority to determine whether criteria and requirements in excess of that contained in this appendix are necessary.

Early agreement between the applicant and the FAA should be reached on the proposed certification plan. Upon completion of an FAA engineering design review and supporting simulation studies, a type inspection authorization (TIA) should be issued to determine if the complete installation of the equipment associated with Category II operations meets the criteria of this appendix.

7.1. Performance Evaluation. Performance for an airborne system intended to meet provisions of this Appendix should be demonstrated by flight test.

The airborne system should be demonstrated in at least the following conditions taking into account manual/coupled autopilot, autothrottle configurations for Category II approaches:

a. Wind Conditions:

20 kts - Head wind component

10 kts - Crosswind component

10 kts - Tailwind component

ATS reported surface winds, or equivalent, may be used.

b. Performance shall be demonstrated by flight test, or analysis validated by flight test, using at least three different representative facilities for a minimum of 20 total approaches, with a representative range of environmental and system variables which have an effect on overall performance. If more than one approach in the series of approaches attempted are unsuccessful, an additional number of successful approaches may be required, as agreed by the applicant and FAA.

FAA will accept use of the Continuous Method and the Pass/Fail Method, found in JAR ACJ AWO 231, in lieu of the 95% of the time per approach described in sub-sections of 6.2, and the minimum number of 20 approaches stated above.

7.2. Safety Assessment. Except as required by any specific safety related criteria identified in this appendix, or by the operating rules, a safety assessment of the Approach system, considered separately and in conjunction with other systems, shall be conducted to show compliance with section 25.1309.

8. AIRBORNE SYSTEM REQUIREMENTS. This section identifies criteria applicable to specific aircraft system architecture selected to conduct the operation. This criteria is developed from operational considerations, approach system considerations, airplane system considerations, and the general operational philosophy contained in the body of this AC.

8.1. General. Various airplane systems are expected to comply with the basic performance, integrity, and availability requirements as identified in Section 6 of this Appendix.

8.2. Autopilot. 14 CFR section 25.1329 is applicable to autopilot systems. Guidance material concerning these installations is provided in a separate Advisory Circular.

8.3. Head-down Guidance. The following criteria is applicable to Head-down Guidance systems:

A flight director system, or alternative form of guidance, must be designed so that the probability of display of incorrect guidance commands is remote.

Wherever practical, a fault must cause guidance information to be immediately removed from view. If a warning is given instead, it must be such that the pilot will observe the warning while using the information.

8.4. Head-up Guidance. The following criteria is applicable to Head-up Guidance systems:

a. The workload associated with use of the HUD should be considered in showing compliance with section 25.1523.

b. The HUD display medium must not significantly obscure the pilot's view through the cockpit window.

c. Control of Approach Flight Path - the HUD must provide sufficient guidance information, without excessive reference to other cockpit displays, to enable a suitably trained pilot to:

(1) maintain the approach path,

(2) go-around.

d. The pilot should be able to align with the runway without the HUD adversely affecting the pilot task. If command information is provided for the flare and landing, it must not be misleading and should be consistent with the characteristics of normal manual maneuvers.

e. If only one HUD is installed, it should be installed at the pilot-in-command crew station.

f. The HUD guidance must not require exceptional piloting skill to achieve the required performance.

g. The HUD system performance and alerting should be consistent with the intended operational use for duties and procedures of the pilot flying (PF) and pilot not flying (PNF) (see sections 5.6 and 5.8 of the main body of this AC).

h. If the autopilot is used to control the flight path of the airplane to intercept and establish the approach path, the point during the approach at which the transition from automatic to manual flight takes place shall be identified and used for the performance demonstration.

i. Any transition from autopilot to HUD guidance must not require exceptional piloting skill, alertness, strength, or excessive workload.

j. A flight director system, or alternative form of guidance, must be designed so that the probability of display of incorrect guidance commands is remote.

k. Wherever practical, a fault must cause guidance information to be immediately removed from view. If a warning is given instead, it must be such that the pilot will observe the warning while using the information.

8.5. Hybrid HUD/Autoland Systems [PoC]. The following criteria is applicable to Hybrid systems:

a. If a HUD is used to monitor an autoflight system, it should be shown to be compatible with the autoflight system and permit a pilot to detect unsuitable autopilot performance.

b. Other hybrid systems (e.g., including EVS) require a proof of concept **[PoC]** evaluation to establish suitable criteria.

8.6. Autothrottle. For Category II, an autothrottle should meet the provisions of paragraph 8.8 of Appendix 2, and in addition:

a. Hold speed within ± five knots of the intended speed, except for momentary gusts, in typical environmental conditions expected for use;

b. Provide appropriate status, advisory, caution and warning information for failures;

c. Provide timely application of "Go-around thrust" if a go-around mode is available; and

d. Not require undue crew attention or skill to recognize and respond to an engine failure during approach or go-around.

9. AIRPLANE FLIGHT MANUAL (AFM). The AFM should contain the following information:

a. Any conditions or constraints on approach performance with regard to airport conditions (e.g., elevation, ambient temperature, approach path slope, runway slope and ground profile under the approach path).

b. The criteria used for the demonstration of the system, acceptable normal and non-normal procedures, the demonstrated configurations, and types of facilities used, and any constraints or limitations necessary for safe operation.

c. The type of navigation facilities used as a basis for certification. This should not be taken as a limitation on the use of other facilities. The AFM may contain a statement regarding the type of facilities or condition known to be unacceptable for use.

d. Information should be provided to the flightcrew regarding atmospheric conditions under which the system was demonstrated e.g., headwind, crosswind, tailwind etc. The AFM should contain a statement that "Credit may not be predicated on the use of <type of system> if conditions exceed … (those for which the system received airworthiness approval).

NOTE 1: The AFM limitation section should not specify DA(H) or Runway Visual Range (RVR) limitations.

NOTE 2: AC 25.1581-1, Airplane Flight Manual, Section 2 discusses AFM contents. The approval status referenced in 2 b (9) (vii) for Category I, II, or III of that AC should be noted in the Normal Procedures Section of the AFM, in accordance with the above provisions.

APPENDIX 3.

DEFINITIONS AND ACRONYMS

This Appendix contains the definition of terms and acronyms used within this Advisory Circular (AC). The appendix also contains certain terms that are not used in this Advisory Circular but are used in related Advisory Circulars and are included for convenient reference. Certain definition of terms and acronyms are also provided to facilitate common use of this Appendix for other related Advisory Circulars.

Definitions

Actual Navigation Performance (ANP)	A measure of the current estimated navigation performance, excluding Flight Technical Error (FTE).
	Actual Navigation Performance is measured in terms of accuracy and integrity, and may be affected by the type and availability of navigation signals and equipment.
	NOTE: Also see Estimated Position Uncertainty [EPU].
"Advanced" airplanes	In this document, airplanes equipped similar to the "Standard" airplane but with advance navigation capabilities (e.g., GPS sensors and RNP approval) and possibly enhanced situation awareness systems such as Terrain Awareness Warning System (TAWS, EGPWS, etc.)
Aeronautical Chart Critical data	Data for Aeronautical charts determined IAW RTCA/DO-200A or ICAO Annex 4 criteria considered to have a Critical level of data integrity [e.g., Probability of Undetected Corruption $\leq 1 \text{ X } 10^{-9}$].
Aeronautical Chart Essential data	Data for Aeronautical charts determined IAW RTCA/DO-200A or ICAO Annex 4 criteria considered to have an essential level of data integrity [e.g., Probability of

	Undetected Corruption ≤ 1 X 10^{-5}].
Aeronautical Chart Routine data	Data for Aeronautical charts determined IAW RTCA/DO-200A or ICAO Annex 4 criteria considered to have a routine level of data integrity [e.g., Probability of Undetected Corruption is not Applicable].
Approach Intercept Waypoint (APIWP)	A variable waypoint used when necessary to link a barometric LNAV/VNAV flight path with a Final Approach Segment (FAS) that is fixed in space (e.g., an xLS final segment). The APIWP permits LNAV and barometric VNAV segments, which may vary vertically in location on an approach as a function of barometric pressure setting or temperature variation from standard, to join or be connected to a FAS which is otherwise fixed in vertical location with respect to a runway.
Automatic Dependent Surveillance (ADS)	A surveillance technique in which airplanes automatically provide, via data link, data derived from on-board navigation and position fixing systems, including airplane identification, four dimensional position and additional data as appropriate (ICAO – IS&RP Annex 6).
Airborne Navigation system	The airborne equipment that senses and computes the airplane position relative to the defined path and provides information to the displays and to the flight guidance system. It may include a number of receivers and/or system computers such as a Flight Management Computer and typically provides inputs to the Flight Guidance System.
Area Navigation (RNAV)	A method of navigation that permits airplane operations on any desired course within the coverage of station-referenced navigation signals or within the limits of self-contained system capability (14 CFR part 1).
Automatic Go-Around	A Go-Around which is accomplished by an autopilot following pilot selection and initiation of the "Go-Around" autopilot mode.
Availability	An expectation that systems or elements required for an operation will be available to perform their intended functions so that the operation will be accomplished as planned to an acceptable level of probability.
Balked Landing	A discontinued landing attempt. Term is often used in conjunction with airplane configuration or performance assessment, as in "Balked landing climb gradient"; Also see "Rejected Landing."
Catastrophic Failure Condition	Failure Condition which would result in multiple fatalities, usually with the loss of the airplane.
Category I (US)	ILS approach procedure which provides for approach to a height above touchdown of not less than 200 ft with runway visual range of not less than 1800 ft. (AIM).
(ICAO)	A precision instrument approach and landing with a decision height not lower than 60m (200 ft) and with either a visibility not less than 800m (2400 ft), or a runway visual range not less than 550m (1800 ft). (adapted from ICAO – IS&RP Annex 6).
Category II (US)	An ILS approach procedure which provides for approach to a height above touchdown of not less than 100 ft and with runway visual range of not less than 1200 ft. (AIM).
(ICAO)	An instrument approach or approach and landing with a decision height lower than 60m (200 ft) but not lower than 30m (100 ft) and a runway visual range not less than 350m (1200 ft) (adapted from ICAO – IS&RP Annex 6).
Category IIIa (US)	An ILS approach and landing with no decision height (DH), or a DH below 100 ft.

	(30 meters), and controlling runway visual range not less than 700 ft. (200 meters) (14 CFR part 1).
(ICAO)	An instrument approach and landing with a decision height lower than 30m (100 ft), or no decision height and a runway visual range not less than 200m (700 ft) (adapted from ICAO – IS&RP Annex 6).
Category IIIb (US)	An ILS approach and landing with no DH, or with a DH below 50 ft. (15 meters) and controlling runway visual range less than 700 ft. (200 meters), but not less than 150 ft. (50 meters) (14 CFR part 1).
(ICAO)	An instrument approach and landing with a decision height lower than 15m (50 ft), or no decision height and a runway visual range less than 200m (700 ft) but not less than 50m (150 ft). (adapted from ICAO – IS&RP Annex 6). .
Category IIIc (US)	An ILS approach and landing with no DH and no runway visual range limitation (14 CFR part 1).
(ICAO)	An instrument approach and landing with or without a decision height, with a runway visual range less than 50m (150 ft). (adapted from ICAO-IS&RP Annex 6).
Certificate Holding District Office (CHDO)	That FAA Flight Standards District Office (FSDO), Certificate Management Office (CMO), or Certificate Management Unit (CMU) assigned by FAA to have operating certificate oversight responsibility for a particular operator.
Class I Navigation	Navigation within the service volume of an ICAO Standard NAVAID.
Class II Navigation	A flight operation or portion of a flight operation (irrespective of the means of navigation) which takes place outside (beyond) the designated Operational Service Volume of an ICAO standard airway navigation facility or NAVAID (e.g., VOR, VOR/DME, NDB).
"Classic" airplanes	In this document, airplanes typically equipped with electro-mechanical flight instruments, basic navigation capability (i.e., VOR, DME, ADF) and possibly first generation Inertial Navigation System (INS)).
Combiner	The element of the HUD in which the pilot simultaneously views the external visual scene along with synthetic information provided in symbolic form.
Command Information	Information that directs the pilot to follow a course of action in a specific situation (e.g., Flight Director).
Conformal Information	Information which correctly overlays the image of the real world, irrespective of the pilots viewing position.
Decision Altitude (DA)	A specified altitude in the precision approach at which a missed approach must be initiated if the required visual reference to continue the approach has not been established. Used in lieu of MDA for LNAV/VNAV instrument approaches. (Adapted from ICAO - IS&RP Annex 6).
Decision Height (DH)	A specified height in the precision approach at which a missed approach must be initiated if the required visual reference to continue the approach has not been established (Adapted from ICAO - IS&RP Annex 6).
Decision Altitude (Height) DA	For Category I, a specified minimum altitude in an approach by which a missed

(H)	approach must be initiated if the required visual reference to continue the approach has not been established. The "Altitude" value is typically measured by a barometric altimeter or equivalent (e.g., Inner Marker) and is the determining factor for minima for Category I Instrument Approach Procedures. The "Height" value specified in parenthesis is typically a radio altitude equivalent height above the touchdown zone (HAT) used only for advisory reference and does not necessarily reflect actual height above underlying terrain. For Category II and certain Category III procedures (e.g., when using a Fail-Passive autoflight system) the Decision Height (or an equivalent IM position fix) is the controlling minima, and the altitude value specified is advisory. The altitude value is available for cross reference. Use of a barometrically referenced DA for Category II is not currently authorized for 14 CFR part 121, 129 or 135 operations at U.S. facilities (Adapted from ICAO - IS&RP Annex 6).
Defined Flight Path	The flight path as determined by the path definition function of an airplane's navigation system.
Design Eye Box	The three dimensional volume in space surrounding the Design Eye Position from which the Head Up Display (HUD) information can be viewed.
Design Eye Position	The position at each pilot's station from which a seated pilot achieves the optimum combination of outside visibility and instrument scan.
Desired Flight Path	The path that the pilot, or pilot and air traffic service, expect the airplane to fly.
Enhanced Vision System (EVS)	An electronic means to provide the flightcrew with a sensor derived or enhanced image of the external scene (e.g., Millimeter wave radar, FLIR).
Estimate of Position Uncertainty [EPU], or Estimated Position Error [EPE]	A measure based on a scale which conveys the current position estimation performance - Also called Estimated Position Error (EPE).
Extended Final Approach Segment (EFAS)	That segment of an approach, co-linear with the Final Approach Segment, but which extends beyond the Precision Final Approach Fix (PFAF) or Approach Intercept Waypoint (APIWP).
External Visual Reference	Information the pilot derives from visual observation of real world cues outside the cockpit.
Extremely Improbable	A probability of occurrence on the order of 1×10^{-9} or less per hour of flight, or per event (e.g., take-off, landing).
Extremely Remote	A probability of occurrence between the orders of 1×10^{-9} and 1×10^{-7} per hour of flight, or per event (e.g., take-off, landing).
Fail Operational System	A system, following the failure of any single system component after passing a point designated by the applicable safety analysis (e.g., Alert Height), that is capable of completing the approach, flare, and landing by the remaining part of the automatic system.
Fail Passive System	A system that, in the event of a failure, causes no significant out-of-trim condition or deviation of an airplane flight path or attitude but the landing is not completed automatically.
Field of View	As applied to a Head Up Display (HUD) - the angular extent of the display that can be seen from within the design eye box.
Fictitious Threshold Point (FTP)	The FTP is equivalent to the LTP. It is the intersection of the final course in a line perpendicular to the final course that passes through the LTP. It is defined by

	latitude, longitude, and ellipsoidal height. (RTCA DO-201)
Final Approach Course (FAC)	The final bearing/radial/track of an instrument approach leading to a runway, without regard to distance. For certain previously designed approach procedures that are not aligned with a runway, the FAC bearing/radial/track of an instrument approach may lead to the extended runway centerline, rather than to alignment with the runway.
Final Approach Fix (FAF)	The fix from which the final approach to an airport is executed. For standard procedures that do not involve multiple approach segments intercepting the runway centerline near the runway, the FAF typically identifies the beginning of the straight-in final approach segment.
Final Approach Point (FAP)	The point applicable to instrument approaches other than ILS, MLS or GLS, with no depicted FAF (e.g., only applies to approaches such as an on-airport VOR or NDB), where the airplane is established inbound on the final approach course from a procedure turn, and where descent to the next procedurally specified altitude, or to minimum altitude, may be commenced.
Final Approach Segment (FAS)	The segment of an approach extending from the Precision Final Approach Fix (PFAF) or Approach Intercept Waypoint (APIWP), whichever occurs later, to Ground Point of Intercept (GPI). For the purpose of procedure construction and obstacle evaluation, the FAS is defined as beginning at the FAF and ending at the Landing Threshold Point (LTP) (RTCA DO-229).
Flight Guidance System	The means available to the flightcrew to maneuver the airplane in a specific manner either manually or automatically. It may include a number of components such as the autopilot, flight directors, relevant display and annunciation elements and it typically accepts inputs from the airborne navigation system.
Flight Path Alignment Point (FPAP)	The FPAP is a point located on a geodesic line or an extension of a geodesic line calculated between the LTP and the designated center of the opposite runway threshold. It is positioned at a distance from the LTP to support a prescribed procedure design angular splay and course width, as well as functionality associated with an airplane. It is used in conjunction with the LTP to determine the lateral alignment of the vertical plane containing the path of the RNAV final approach segment. On shorter runways, the FPAP may be located off the departure end of the landing runway (RTCA DO-201).
Flight Path Control Point (FPCP)	The FPCP is a spatial point above the LTP used to define the vertical component (glide path angle) of the precision final approach path to the landing runway threshold. Vertically, the elevation of the FPCP is the elevation of the LTP plus the threshold crossing height (TCH) (RTCA DO-201).
Flight Technical Error (FTE)	The accuracy with which the airplane is controlled as measured by the indicated airplane position with respect to the indicated command or defined flight path position. NOTE: FTE does not include human performance conceptual errors, typically which may be of large magnitude (e.g., entry of an incorrect waypoint or waypoint position, selection of an incorrect procedure, selection of an incorrect NAVAID frequency, failure to select a proper flight guidance mode. FTE can be influenced by factors such as flightcrew response to guidance (e.g., response to Flight Director information), or external environment conditions such as a wind gradient or turbulence).
"Fly By" Vertical Waypoint	A "Fly By" vertical waypoint (WP) is a WP for which an airplane may initiate a vertical rate or flight path angle change to depart the current segment of a specified vertical path (VNAV path) shortly prior to an active WP, in order to expeditiously capture the next vertical path segment without overshoot.

"Fly Over" Vertical Waypoint	A "Fly Over" vertical waypoint (WP) is a WP for which an airplane must stay on the defined vertical path (VNAV path) until passing an active WP, and may not initiate capture of the next vertical path segment until after passing the active WP.
Frequent	Occurring more often than 1 in 1000 events or 1000 flight hours.
Glide Path Angle (GPA)	The glide path angle is an angle, defined at the FPCP, that establishes the descent gradient for the final approach flight path (e.g., FAS) of an instrument approach procedure. It is measured in the geodesic plane of the approach (defined by the LTP, FPAP, and WGS-84 ellipsoid's geometric center). The vertical and horizontal references for the GPA are a vector normal to the WGS-84 ellipsoid at the LTP and a plane perpendicular to that vector at the FPCP, respectively.
Precision Final Approach Fix (PFAF)	The point at which the established glide slope intercept altitude (MSL) meets the Final Approach Segment (FAS), on a standard day, using a standard altimeter setting (1013.2 HPa or 29.92 in).
Ground Point of Intercept (GPI)	A point in the vertical plane on the runway centerline at which it is assumed that the straight line extension of the glide path intercepts a horizontal line tangent to the surface of the earth at the landing threshold point and aligned with the final approach course. (Order 8260.3).
GPS or GNSS Landing System (GLS)	A differential GPS or GNSS (e.g., WAAS, LAAS, SCAT I) based landing system providing both vertical and lateral position fixing capability. NOTE: Term may be applied to any GNSS based differentially corrected landing system providing lateral and vertical service for approach and landing equivalent to or better than that provided by a U.S. Type I ILS, or equivalent ILS specified by ICAO Annex 10.
Global Positioning System (GPS)	The NAVSTAR Global Positioning System operated by the U.S. Department of Defense. It is a satellite -based radio navigation system composed of space, control and user segments. The space segment is composed of satellites. The control segment is composed of monitor stations, ground antennas and a master control station. The user segment consists of antennas and receiver-processors that derive time and compute a position and velocity from the data transmitted from the satellites.
Global Navigation Satellite System [GNSS]	A world wide position, velocity and time determination system that uses one or more satellite constellations.
Go-around	A transition from an approach to a stabilized climb.
Guidance	Information used during manual control, automatic control, or monitoring of automatic control of an airplane that is of sufficient quality to be used by itself for the intended purpose of achieving a particular flight path.
Hazardous Failure Condition	Failure Conditions which would reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions to the extent that there would be: (i) A large reduction in safety margins or functional capabilities; (ii) Physical distress or higher workload such that the flightcrew cannot be relied upon to perform their tasks accurately or completely; or (iii) Serious or fatal injury to a relatively small number of the occupants.

Head Up Display System	An airplane system which provides head-up guidance to the pilot during flight. It includes the display element, sensors, computers and power supplies, indications and controls. It may receive inputs from an airborne navigation system or flight guidance system.
Height Above Airport (HAA)	The height of the Minimum Descent Altitude above the published airport elevation. This is published in conjunction with circling minimums. (AIM)
Height Above Touchdown (HAT)	The height of the Decision Height or Minimum Descent Altitude above the highest runway elevation in the touchdown zone (first 3,000 feet of the runway). HAT is published on instrument approach charts in conjunction with all straight-in minimums. (AIM)
Hybrid System	A combination of two, or more, systems of dissimilar design used to perform a particular operation.
Improbable	A probability of occurrence greater than 1×10^{-9} but less than or equal to 1×10^{-5} per hour of flight, or per event (e.g., take-off, landing).
Independent Landing Monitor (ILM)	A millimeter wave radar based sensor (e.g., typically transmitting at 35 GHz, or 94 GHz) used to present a perspective display of a runway to a pilot on an electronic flight deck display during approach, to serve as an independent integrity monitor for another type of landing NAVAID sensor (e.g., ILS, MLS or GLS).
Independent Systems	A system that is not adversely influenced by the operation, computation, or failure of some other identical, related, or separate system (e.g., two separate ILS receivers).
Infrequent	Occurring less often than 1 in 1000 events or 1000 flight hours.
Missed Approach Turn Waypoint (MATWP)	A Waypoint generally aligned with the runway centerline, beyond the touchdown zone, used to establish a suitable initial climb segment beyond the touchdown zone. The MATWP intends to provide a safe path and altitude, if applicable, in the vicinity of the runway, to be used to establish a safe initial go-around path following a low altitude go-around or rejected landing.
Initial Missed Approach Segment (IMAS)	That segment of an approach from the Ground Point of Intercept (GPI) to the Missed Approach Turn Waypoint (MATWP).
Instantaneous Field of View	The angular extent of a HUD display which can be seen from either eye from a fixed position of the head.
Integrity	A measure of the acceptability of a system or system element, to contribute to the required safety of an operation.
Landing	For the purpose of this AC, landing will begin at 100 ft. or the DH to the first contact of the wheels with the runway.
Landing Rollout	For the purpose of this AC, rollout starts from the first contact of the wheels with the runway and finishes when the airplane has slowed to a safe taxi speed (in the order of 30 knots).
Landing Threshold Point (LTP)	The LTP is used in conjunction with the FPAP and the vector normal to the WGS-84 ellipsoid at the LTP to define the geodesic plane of a final instrument approach flight path to touchdown and rollout (e.g., FAS). It is a point at the designated center of the landing threshold and is defined by a specified latitude, longitude, and ellipsoidal height. The LTP is a reference point used to connect the approach flight path with the runway (RTCA DO-201).

Major Failure Condition	Failure Condition which would reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions to the extent that there would be, for example, a significant reduction in safety margins or functional capabilities, a significant increase in crew workload or in conditions impairing crew efficiency, or discomfort to occupants, possibly including injuries.
Minimum Descent Altitude (MDA) (U.S.)	The lowest altitude, expressed in feet, above mean sea level, to which descent is authorized on final approach or during circle-to-land maneuvering in execution of a standard instrument approach procedure, where no electronic glide slope is provided (14 CFR part 1).
(ICAO)	A specified altitude in a Nonprecision approach or circling approach below which descent must not be made without the required visual reference. Minimum Descent Altitude (MDA) is referenced to mean sea level. (ICAO - IS&RP Annex 6).
Minimum Descent Height (MDH)	A specified height in a Nonprecision approach or circling approach below which descent must not be made without the required visual reference. Minimum Descent Height (MDH) is referenced to aerodrome elevation or to the threshold if that is more than 7 ft. (2m) below the aerodrome elevation. A MDH for a circling approach is referenced to the aerodrome elevation (ICAO - IS&RP Annex 6). NOTE - The U.S. does not use Minimum Descent Heights.
Minimum Use Height (MUH)	A height specified during airworthiness demonstration or review above which, under standard or specified conditions, a probable failure of a system is not likely to cause a significant path displacement unacceptably reducing flight path clearance from specified reference surfaces (e.g., airport elevation) or specified obstacle clearance surfaces.
Minor Failure Condition	Failure Condition which would not significantly reduce airplane safety and which involve crew actions that are well within their capabilities. Minor Failure Conditions may include, for example, a slight reduction in safety margins or functional capabilities, a slight increase in crew workload, such as routine flight plan changes, or some inconvenience to occupants.
Missed Approach	The flight path followed by an airplane after discontinuation of an approach procedure and initiation of a go-around. Typically a "missed approach" follows a published missed approach segment of an instrument approach procedure, or follows radar vectors to a missed approach point, return to landing, or diversion to an alternate.
Missed Approach Segment (MAS)	That segment of an instrument approach procedure from a point on the FAS corresponding to the position where the lowest DA(H) occurs under nominal conditions, to the designated missed approach holding WP, as specified for the procedure.
Monitored Head Up Display (HUD)	A HUD which has internal or external capability to reliably detect erroneous sensor inputs or guidance outputs, to ensure that a pilot does not receive incorrect or misleading guidance, failure, or status information.
Navigation System Error	An error in the estimation of the airplane’s position. Also called "position estimation error."
Non-Normal Means of Navigation	A means of navigation which does not satisfy one or more of the necessary levels of accuracy, integrity, and availability for a particular area, route, procedure or operation, and which may require use of a pilot’s "emergency authority" to continue navigation.

Non-normal conditions	Conditions other than those considered normal conditions (e.g., Failure conditions, certain kinds of error conditions).
Nonprecision Approach Procedure	A standard instrument approach procedure in which no electronic glide slope is provided. (14 CFR part 1).
NOTAM	Notice to Airmen - A notice distributed by means of telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure, or hazard, the timely knowledge of which is essential to personnel concerned with flight operations. (ICAO - IS&RP Annex 6).
Path Definition Error	The difference between the desired path and the defined path. NOTE: This error may be due to survey errors, database resolution limitations, or other such factors.
Path Steering Error	Any resulting difference (i.e., non-zero deviation) between the estimated airplane position from the desired flight path. NOTE: This error includes any display errors along with flight technical error.
Performance	A measure of the accuracy with which an airplane, a system, or an element of a system operates compared against specified parameters. Performance demonstration(s) typically include the component of Flight Technical Error (FTE).
Position Estimation Error	An error in the estimation of the airplane's position. Also called "Navigation System Error."
Precision Approach Procedure	A standard instrument approach procedure in which an electronic glide slope is provided, such as ILS and PAR (14 CFR part 1).
Redundant	The presence of more than one independent means for accomplishing a given function or flight operation. Each means need not necessarily be identical.
Rejected Landing	A discontinued landing attempt. A rejected landing typically is initiated at low altitude but prior to touchdown. If from or following an instrument approach it typically is considered to be initiated below DA(H) or MDA(H). A rejected landing may be initiated in either VMC or IMC. A rejected landing typically leads to or results in a "go around," and if following an instrument approach, a "Missed Approach." If related to consideration of airplane configuration(s) or performance it is sometime referred to as a "Balked Landing." The term "rejected landing" is used to be consistent with regulatory references such as found in 14 CFR part 121 Appendix E, and policy references as in FAA Order 8400.10.
Remote	A probability of occurrence on the order of greater than 1×10^{-7} but less than or equal to 1×10^{-5} per hour of flight, or per event (e.g., take-off, landing).
Required Navigation Performance (RNP)	A statement of the navigation performance accuracy necessary for operation within a defined airspace. Note that there are additional requirements, beyond accuracy, applied to a particular RNP type.
Required Visual Reference	That section of the visual aids or of the approach area which should have been in view for sufficient time for the pilots to have made an assessment of the airplane's position and rate of change of position, in relation to the desired flight path. In Category III operations with a decision height, the required visual reference is that specified for the particular procedure and operations (ICAO - IS&RP Annex 6 - Decision Height definition - NOTE 2).

Runway Segment (RWS)	That segment of an approach from the Ground Point of Intercept (GPI) to Flight Path Alignment Point (FPAP).
Situation Information	Information that directly informs the pilot about the status of the airplane system operation or specific flight parameters including flight path.
"Standard" airplanes	In this document, airplanes with multi-sensor RNAV Flight Management Systems (FMS), Electronic Flight Instruments (EFIS) and Electronic Map Displays. (includes the majority of airplanes manufactured since 1985)
Synthetic Reference	Information provided to the flightcrew by instrumentation or electronic displays, that is electronically generated, processed, enhanced, or otherwise augmented. Information may be either command or situation information (e.g., SVS, EVS).
Synthetic Vision System (SVS)	A system used to create a synthetic image (e.g., typically a computer generated picture) representing the environment external to the airplane.
Take-off Guidance System	A system which provides directional command guidance to the pilot during a take-off, or take-off and aborted take-off. It includes sensors, computers and power supplies, indications and controls.
Threshold Crossing Height (TCH)	The height of the Flight Path Control Point (FPCP) above the Landing Threshold Point (LTP). NOTE: The FPCP may be specified in units of feet or meters, but is typically specified in units of feet.
Total Field of View	The maximum angular extent of the display that can be seen with either eye, allowing head motion within the design eye box.
Total System Error (TSE)	The difference between the desired flight path and the actual flight path. Typically determined by a sum of the path definition error, navigation system error and the path steering error (i.e., flight technical error plus any display error).
Touch Down Zone (TDZ)	The first 3000 ft. of usable runway for landing, unless otherwise specified by the FAA, or other applicable ICAO or State authority (e.g., for STOL airplanes, or IAW an SFAR).
"Type" facility	The term "type" is used to differentiate the ground guidance facility from the "category" of flight operations (i.e., Type I ILS facility as opposed to CAT I operation).
Visual Glide Slope Indicator (VGSI)	An electro-optical devise that provides a visual indication of vertical position in relation to a defined glidepath. Specific systems in this classification include the Visual Approach Slope Indicator (VASI), the Precision Approach Path Indicator (PAPI), and Precision Landing Aid Slope Indicator (PLASI) (Order 8260.3).
Visual Guidance	Visual information the pilot derives from the observation of real world cues, out the flight deck window, used as a primary reference for airplane control or flight path assessment.
WGS-84 Ellipsoid	A mathematical model of the earth's shape based on WGS-84 survey information, used as an element of an earth surface referenced navigation coordinate frame (See appropriate ICAO or RTCA references for its technical definition and specification - e.g., ICAO "World Geodetic System 1984 Manual - DOC 9674-AN/946").

Acronyms

ACRONYM	EXPANSION
ABAS	Aircraft Based Augmentation System
AC	Advisory Circular
ADF	Automatic Direction Finder
ADI	Attitude Director Indicator
ADS	Automatic Dependent Surveillance
AFCS	Autopilot Flight Control System
AFDS	Autopilot Flight Director System
AFGS	Automatic Flight Guidance System
AFM	Airplane Flight Manual
AH	Alert Height
AHI	All-Weather Harmonization Items
AIP	Aeronautical Information Publication
ALS	Approach Light System
ANP	Actual Navigation Performance
APIWP	Approach Intercept Waypoint
APM	Aircrew Program Manager
APU	Auxiliary Power Unit
AQP	Advanced Qualification Program
ARA	Airborne Radar Approach
ASR	Airport Surveillance Radar
ATC	Air Traffic Control
ATIS	Automatic Terminal Information Service
ATOGW	Allowable Take-off Gross Weight
ATPC	Airline Transport Pilot Certificate
ATS	Air Traffic Service
AWO	All Weather Operations

BARO	[Abbreviation for "Barometric"]
BC	Back Course (e.g., Localizer Back Course)
BITE	Built-In Test Equipment
CAA	Civil Aviation Authority
CDL	Configuration Deviation List
CFR	Code of Federal Regulations
CFR	Crash Fire Rescue
CHDO	Certificate Holding District Office
CMO	[FAA] Certificate Management Office
CMU	[FAA] Certificate Management Unit
CL	Centerline Lights
CNS	Communication, Navigation, and Surveillance
CRM	Collision Risk Model
CRM	Cockpit Resource Management
CVR	Cockpit Voice Recorder
DA	Decision Altitude
DA(H)	Decision Altitude(Height)
DD	DME-DME updating
DDM	Difference of Depth Modulation
DEP	Design Eye Position
DGNSS	Differential Global Navigation Satellite System
DH	Decision Height
DME	Distance Measuring Equipment
DOD	[U.S.] Department of Defense
DOT	[U.S.] Department of Transportation
DP	Departure Procedure (formerly SID)
EADI	Electronic Attitude Director Indicator
ECEF	Earth Centered Earth Fixed (coordinate frame)

EFAS	Extended Final Approach Segment
EHSI	Electronic Horizontal Situation Indicator
EPE	Estimated Position Error
EPU	Estimated Position Uncertainty
EROPS	Extended Range Operations (any number of engines)
ET	Elapsed Time
ET	Error Term [FMS use]
ETOPS	Extended Range Operations with Two-Engine Airplanes
EVS	Enhanced Vision System
FAF	Final Approach Fix
FAP	Final Approach Point
FAR	Federal Aviation Regulation
FAS	Final Approach Segment
FBS	Fixed Base Simulator
FBW	Fly-by-wire
FCOM	Flightcrew Operating Manual
FDR	Flight Data Recorder
FGS	Flight Guidance System
FHA	Functional Hazard Assessment
FLIR	Forward Looking Infrared Sensor
FM	Frequency Modulation
FM	Fan Marker
FMC	Flight Management Computer
FMS	Flight Management System
FPAP	Flight Path Alignment Point
FPA	Flight Path Angle
FPCP	Flight Path Control Point
FSB	Flight Standardization Board

FSDO	[FAA] Flight Standards District Office
FSS	[FAA] Flight Service Station
FTE	Flight Technical Error
FTP	Fictitious Threshold Point
GA	Go-Around
GBAS	Ground Based Augmentation System
GCA	Ground Controlled Approach
GPI	Ground Point of Intercept (formerly GIRP)
GLS	GPS or GNSS Landing System
GNSS	Global Navigation Satellite System
GPA	Glide Path Angle
GPIWP	Glide Path Intercept Waypoint
GPWS	Ground Proximity Warning System
GPS	Global Positioning System
HAA	Height Above Airport
HAT	Height above Touchdown
HDG	Heading
HQRS	Handling Quality Rating System (see AC25-7A, as amended)
HIS	Horizontal Situation Indicator
HUD	Head Up Display
IAP	Instrument Approach Procedure
IAW	In Accordance With
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
IM	Inner Marker
IMAS	Initial Missed Approach Segment
IMAWP	Initial Missed Approach Waypoint
IMC	Instrument Meteorological Conditions

ILS	Instrument Landing System
INAS	International Airspace System
IOE	Initial Operating Experience
IRS	Inertial Reference System
IRU	Inertial Reference Unit
ISA	International Standard Atmosphere
JAA	Joint Aviation Authority
JAR AWO	Joint Aviation Regulations – All Weather Operations
KRM	[Type of Landing system used in certain foreign States]
LAAS	Local Area Augmentation System
LAD	Local Area Differential
LAHSO	Land And Hold Short Operation
LDA	Localizer-Type Directional Aid
LLM	Lower Landing Minima
LMM	Compass Locator Middle Marker
LLTV	Low Light Level TV
LNAV	Lateral Navigation
LOA	Letter of Authorization
LOC	[ILS] Localizer
LOE	Line Operational Evaluation
LOFT	Line Oriented Flight Training
LOM	Compass Locator Outer Marker
LOS	Line Oriented Simulation
LTP	Landing Threshold Point
MAP	Mode Annunciator Panel
MAP	Missed Approach Point
MAS	Missed Approach Segment
MASPS	Minimum Aviation System Performance Standards

MB	Marker Beacon
MCP	Mode Control Panel
MDA	Minimum Descent Altitude
MDA(H)	Minimum Descent Altitude(Height)
MDH	Minimum Descent Height - NOTE: MDH is not used for US Operations
MEH	Minimum Engage Height
MEL	Minimum Equipment List
METAR	ICAO Routine Aviation Weather Report
MLS	Microwave Landing System
MM	Middle Marker
MMEL	Master Minimum Equipment List
MMR	Multi-mode Receiver
MOT	Ministry of Transport
MRB	Maintenance Review Board
MSL	Mean Sea Level [altitude reference datum]
MUH	Minimum Use Height
MVA	Minimum Vectoring Altitude
NA	Not Authorized or Not Applicable
NAS	National Airspace System
NAVAID	Navigational Aid
ND	Navigation Display
NDB	Navigation Data Base
NDB	Non-directional Beacon
NOTAM	Notice to Airman
NRS	National Resource Specialist
OCA	Obstacle Clearance Altitude
OCH	Obstacle Clearance Height
OCL	Obstacle Clearance Limit

OIS	Obstacle Identification Surface
OM	Outer Marker
OSAP	Offshore Standard Approach Procedure
PAI	Principal Avionics Inspector
PAR	Precision Approach Radar
PC/PT	Proficiency Check/Proficiency Training
PF	Pilot Flying
PFC	Porous Friction Coarse [runway surface]
PIC	Pilot in Command
PIREP	Pilot Weather Report
PNF	Pilot Not Flying
PoC	Proof of Concept
POI	Principal Operations Inspector
PMI	Principal Maintenance Inspector
PRD	Progressive Re-Dispatch
PRM	Precision Radar Monitor
PTS	Practical Test Standard
QFE	Altimeter Setting referenced to airport field elevation
QNE	Altimeter Setting referenced to standard pressure (1013.2HPa or 29.92")
QNH	Altimeter Setting referenced to airport ambient local pressure
QRH	Quick Reference Handbook
RA	Radio Altitude or Radio Altimeter
RAIL	Runway Alignment Indicator Light System
RCLM	Runway Center Line Markings
RCP	Required Communication Performance
RDMI	Radio Direction Magnetic Indicator
REIL	Runway End Identification Lights
RII	Required Inspection Item

RMI	Radio Magnetic Indicator
RMP	Required Monitoring Performance (e.g., surveillance)
RMS	Root-mean-square
RNAV	Area Navigation
RNP	Required Navigation Performance
RNPx2	RNP Containment Limit (2 times RNP value)
RSP	Required System Performance (Considers RNP, RCP, and RMP)
RTCA	RTCA (formerly Radio Technical Commission for Aeronautics)
RTS	Return to Service
RTO	Rejected Take-off
RVR	Runway Visual Range
RVV	Runway Visibility Value
RWS	Runway Segment
RWY	Runway
SA	Selective Availability
SARPS	ICAO Standards and Recommended Practices
SBAS	Space Based Augmentation System
SDF	Simplified Directional Facility
SFL	Sequence Flasher Lights
SIAP	Standard Instrument Approach Procedure
SIC	Second In Command
SLF	Supervised Line Flying
SMGCP	Surface Movement and Guidance Plan
SMGCS	Surface Movement Guidance Control System
STAR	Standard Terminal Arrival Route
STC	Supplemental Type Certificate
STOL	Short Take-off and Landing
SRE	[Type of Landing system used in certain foreign States]

SV	Space Vehicle
TACAN	Tactical Air Navigation system [NAVAID]
TAF	Terminal Aviation Forecast
TAWS	Terrain Awareness and Warning System
TC	Type Certificate
TCH	Threshold Crossing Height (formerly RDP)
TDZ	Touchdown Zone
TERPS	[U.S.] Standard for Terminal Instrument Procedures
TLS	Target Level of Safety
TOGA	Take-off or Go-Around [FGS Mode]
TSE	Total system error
uA	micro amps
VGSI	Visual Glide Slope Indicator
VDP	Visual Descent Point
VFR	Visual Flight Rules
VHF	Very High Frequency
VIS	Visibility
VOR	VHF Omni-directional Radio Range
VORTAC	Co-located VOR and TACAN
VMC	Visual Meteorological Conditions
VNAV	Vertical Navigation
V_1	Take-off Decision Speed
V_{ef}	Engine Failure Speed
$V_{failure}$	Speed at which a failure occurs
V_{lof}	Liftoff Speed
V_{mcg}	Ground Minimum Control Speed
WAAS	Wide Area Augmentation System

WAD	Wide Area Differential
WAT	Weight, Altitude and Temperature
WGS	World Geological Survey
WGS-84	World Geological Survey - 1984
WP	Waypoint
xLS	[Generic term used to denote any one or more of the following NAVAIDs: ILS, MLS, or GLS]